JOURNAL

OF THE

Elisha Mitchell Scientific Society

VOL. XXVII
1911

ISSUED QUARTERLY

THE UNIVERSITY PRESS.
CHAPEL HILL, N. C.

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VOL. XXVII MAY, 1911 NO. 1

A STUDY OF SOME EPITHELIOID MEMBRANES IN MONAXONID SPONGES

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TWENTY-ONE FIGURES

In the course of some experiments dealing with the regenerative power of the tissues in certain monaxonid sponges, it became necessary to learn the histological peculiarities of the epidermis in these forms It soon developed that the adult epidermis in these species did not conform to the type usually thought of us as well nigh universal in sponges. A study of the regenerationof the epidermis in cuttings was then undertaken, rather with the idea of its throwing light on the adult structure. During the study of the epidermis some new facts as to the way in which pores close were made out. Finally for the purpose of comparison with the epidermis, the canal epithelium in a suitable species was studied.[1]

THE EPIDERMIS IN STYLOTELLA.

The most abundant sponge in Beaufort harbor is Stylotella heliophila, a form which I have described in a paper now in press for the U. S. Bureau of Fisheries. The genus falls in the halichondrine monaxonida. The sponge has well marked ascending lobes

*Reprinted from *The Journal of Experimental Zoology*, Vol. 9, No. 3.

[1]The work was carried on during the summer of 1909 at the Beaufort Laboratory of the U. S. Bureau of Fisheries. My thanks are due to Hon. Geo. M. Bowers, U. S. Commissioner of Fisheries, for a place in the laboratory, and to the Director, Mr. H. D. Aller, for his kindly aid during my stay.

of conical shape which bear terminal oscula. The pores are scattered over the whole surface. Spaces of considerable size (subdermal cavities) belonging to the afferent system lie close to the surface, and as is customary in such sponges imperfectly separate a thin superficial layer known as the dermal membrane from the inner mass of the sponge body. The dermal membrane contains no flagellated chambers, or only a very few scattered here and there, and is made up of a thin sheet of mesenchyme containing spicules, which is covered on the outer surface by the epidermis and on the inner surface by the epithelioid membrane forming the wall of the subdermal space (and of the canal in general) According to the current conceptions of the histological structure of sponges we would expect to find the epidermis and canal walls both to consist of a single layer of flat epithelium cells (pinacocytes.)

Actually I find that the epidermis of this sponge consists of a thin protoplasmic sheet studded with nuclei and exhibiting absolutely no cell boundaries. It is a syncytium. Cell boundaries are sometimes overlooked, but it seems to me that the variety of histological methods I have practiced makes it certain that cells do not exist.

Results with material fixed in alcohol.

Comparison with living tissues shows that strong alcohol, absolute or 95 per cent, is an excellent fixative for sponge tissues. I use it in liberal quantities, and very shortly after the immersion of the piece of sponge, change to fresh alcohol, changing again after a few hours. The precipitate which alcohol unfortunately causes in seawater has scarcely time to settle on the sponge if the first change be made quickly. Moving the piece about in the alcohol also helps to keep the surfaces clear of the precipitate. Suitable pieces were stained in toto with haemalum and were then imbedded, some in celloidin, some in paraffine. On the whole I recommend the celloidin, but the paraffin preparations were satisfactory. After the xylol bath I add soft (40° melting point) paraffine to the xylol, warm the mixture up gradually and imbed 30 minutes in soft and 30 minutes in harder (50°--55° melting

point) paraffine. Very thick tangential sections are made. Such sections are far better than thin ones. They afford many places where, owing to the transparency of the tissues underlying the epidermis, the latter can be well seen. The sections were given an after stain with congo red, or with Delafield's haematoxlin followed by congo, and were mounted in balsam. To obviate the possible ill effects of imbedding, strips of the epidermis were torn off with forceps from the alcoholic material, were stained in haemalum and congo red, and mounted in balsam. Most of the pieces obtained in this way are too thick for study, but occasionally very thin strips peel off.

As is well known the pores of sponges close and open. Preparations of the epidermis with the pores widely open were made from sponges that had been kept in a live box. In a live box placed where the tidal current is good, the sponge is usually found with the oscula and pores fully open and the canals dilated. If the sponge so expanded be suddenly plunged in the fixative, the pores will not have time to contract. More useful preparations are those in which the pores are closed or half closed. Sponges that have been kept a short time in running aquaria are found to be in this condition.

A part of the dermal membrane as seen in a thick tangential section is shown in fig. 1 Some of the pores are completely open and others nearly so. The wall of a small subdermal cavity is indicated by the line *s. c. w.*, and into this cavity the pores open. Beyond *s. c. w.*, we come to a thicker part of the body separating the subdermal space shown from neighboring ones. In this part a few conspicuous mesenchyme cells, *m. c.*, appear. They come into view when the microscope is focussed just below the surface of the sponge. The canal wall shows some of the lining cells, *c. c.*, as seen in optical section. They also appear of course only at a focus below the surface of the sponge. Over the subdermal cavity the figure shows the epidermis in focus. It appears as a continuous thin protoplasmic sheet without cell boundaries and studded with nuclei, *ep. n.* On focussing below the epidermis the mesenchyme cells of the dermal membrane would

come into view. Below the mesenchyme lies the inner covering of the dermal membrane, an epithelioid layer continuous with the canal lining in general. Round most of the epidermal nuclei the protoplasm is aggregated, forming thickened more deeply staining areas which shade off into the internuclear portion. The structures marked *p. m.*, which I propose to call pore membranes, and which so far as I know have not been described, are extensions of the epidermal sheet over the pores. These extensions are so thin that they afford an especially favorable opportunity for studying the intimate structure of the epidermal layer. Their nature is learned when the process of pore closure is studied, and it will be well now to give a description of this process.

The dermal pores of the monaxonid sponges are customarily referred to as mere perforations of the dermal membrane. They are in reality short canals leading from the exterior into the subdermal chambers. Ordinarily the dermal membrane, while thin, is of such thickness that the actual aperture at the surface of the sponge is distinguishable, on focussing, from the canal itself. Thus in fig. 1, the pore membrane, *p. m.* partially closes the aperature and is distinctly seen when the epidermis is in focus. On focussing a little lower the wall of the canal itself *p. c.* comes into view as a distinct line which often exhibits a nucleated thickening or two. The nucleated thickening may as in the case of two of the pores shown in figure 1 extend out into the mesenchyme in the shape of a slender process. I propose to restrict the use of the term pore (viz., dermal pore), to the actual aperture, and to designate the short canal as the pore canal.

When the pores are widely open as is the case with pore 1, in fig. 1, there is no sign of a pore membrane. The epidermis is directly continuous at the edge of the pore with the lining of the pore canal. But even when the sponges are fixed at once on being taken from the live box, some of the pores will be partially closed and will show the pore membrane, *p. m.* This thin extension of the epidermal sheet in sponges so preserved will usually be found barely extending beyond the margin of the pore

and it may or may not include a nucleus. It is a single thin layer which yet is continuous with both epidermis and the lining of the pore canal. Since it has the structure of the epidermis I speak of it and regard it as an extension of that layer. If the sponge has been kept in an aquarium a short time, preparations show that the pores are for the most part about half closed. In fig. 3 two such pores are shown as they appear in a thick tangential section similar to that from which fig. 1 was made. The pore membrane, *p. m.*, here extends well over the pore canal. If the sponges have been kept some time in the aquarium, regions will be found in which the pores are closed. Fig. 2 represents the dermal service of a thick tangential section. The region shown lies over a subdermal cavity and the pores are closed. The outlines of the pore canals, *p. c.*, are visible on focussing just below the surface. The thin sheet, *p. m.*, covering in the pore canal is the pore membrane. A comparison of such preparations shows plainly that the pores are closed by a thin extension of the epidermis over the pore canal.

Owing to the peculiarities of the species, especially unevenness of surface, abundance of spicules, and abundance of amoebocytes, it is well nigh impossible to observe the closure of the pores in living preparations of the dermal membrane as made from the normal sponge. Free hand tangential sections of the living sponge were sliced off, but these proved of no value. Pieces were cut off from the upper part of the oscular lobes in very transparent regions and where the wall of the lobe is thin, but these again were useless for the purpose. I did succeed, however, in observing the closure of the pores in life by practicing the following method.

Free hand sections about one-eighth inch thick were made transversely through an oscular lobe, and therefore directly across two or three of the main efferent canals. Such a section when cut is a circular piece of sponge tissue perforated by the segments of these canals. The segments of the canals are of course open above and below at each surface of the section. If such a section be kept a day in an aquarium a new dermal membrane develops

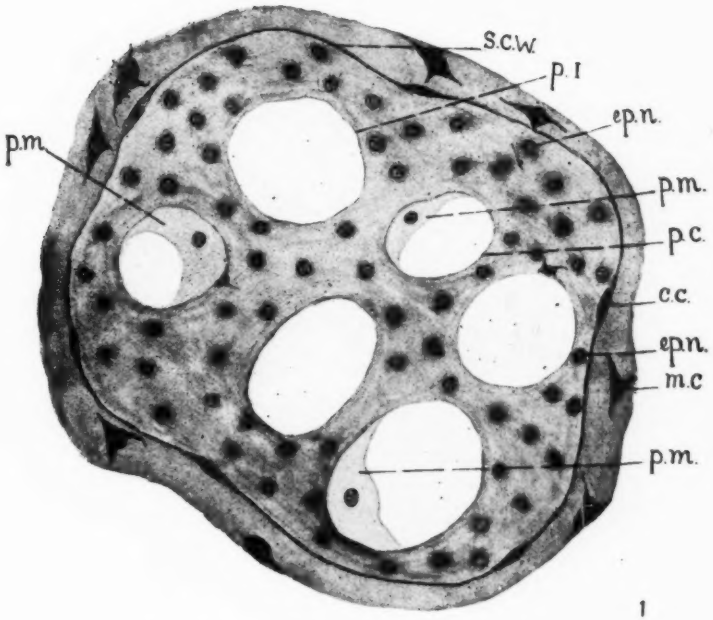
over both surfaces and over the open ends of the canals. The new membrane closing in the canals is smooth and contains but few spicules. If the section now be mounted in sea water under a cover glass the new membrane over the canals may be studied with a high objective. It will be found to contain pores and one may actually see that these are closed through the creeping of the most superficial layer of the dermal membrane (newly formed epidermis) across the pore, *i. e.*, over the aperture of the pore canal, thus giving rise to a pore membrane.[2] As to the opening of the pores after closure by the pore membranes, I have no actual observations, but it is obvious that the pore must reappear as a perforation in the membrane, which the recedes towards the margin of the pore canal.

The question may be asked, is the pore canal a permanent structure, or does it too close up? Since the pore canal perforates the dermal membrane its closure obviously could only be brought about through an extension of the mesenchyme of that membrane. In Stylotella I always find the pore canals distinct even when the pores are completely closed. Hence the pore canals must be regarded as structures that are permanent in ordinary conditions of the sponge. My observations on Reniera and Lissodendoryx (vide infra) nevertheless show that the pore canal itself may be partially or completely obliterated in monaxonid sponges.

Another question may be asked before we leave this matter of the pore and closure. Is there any one nucleus that is especially associated with a pore membrane? An examination of figs. 1, 2 and 3 shows there is no such nucleus. The pore membrane may spread to a considerable distance over the pore canal before any of the epidermal nuclei enter it (fig. 3), and when the pore is completely closed (fig. 2) the membrane may show a nucleus somewhere near its center or again one or two nuclei near or at

[2]In the healing up of such a section a considerable rearrangement of the canal system certainly takes place. A new osculum is established, and this apparently may develop at any point on the surface of the piece. Pore canals lead through the newly formed dermal membrane into what were originally main efferent canals.

PLATE I.



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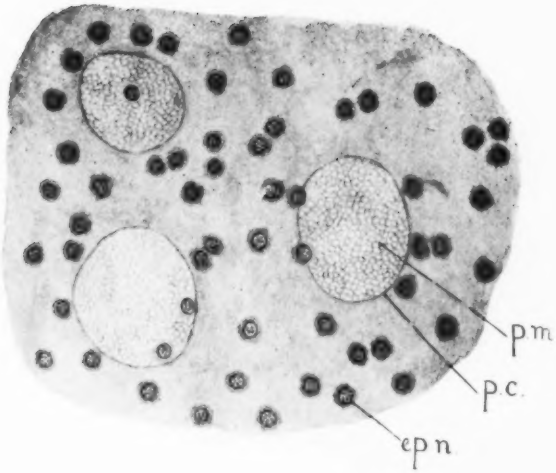

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its margin. The epidermal nuclei are irregularly distributed, in some spots close together, in others farther apart. This is well shown in fig. 2. These nuclei moreover are all alike. The facts would seem to indicate that the epidermal sheet of protoplasm spreads of its own initiative over the pore canal, and that the nearest nucleus or nuclei are simply drawn into it. In Reniera on the other hand there is always one nucleus at the margin of the pore and this nucleus is (perhaps only passively) associated with the formation of the pore membrane.

Some details in the structure of the epidermal layer remain to be mentioned. The irregular distribution of the nuclei has been noted. They are small and uniformly exhibit only a nuclear membrane and a few chromatin granules in the nucleoplasm. No cases of division were observed, although mitotic figures in amoebocytes of the mesenchyme were noticed not infrequently. Round each nucleus or group of two or three is a more deeply staining area which appears finely granular or granular and reticular. The rest of the membrane stretching between the nuclei and over the pore canals exhibits a fine reticular structure. The reticular structure is found everywhere, but is most distinct in the thin pore membranes. Discreet granules are absent or nearly absent in the epidermal sheet. It should be understood that the reticular appearance of the epidermal layer is perhaps only the optical expression of an alveolar structure. To demonstrate the reticular appearance a good immersion objective is necessary. I have chiefly used Zeiss 2 mm. ap. 1.30 but also Zeiss 2 mm. ap. 1.40, with comp. oculars 6 and 8. Very white clouds on sunny days afford satisfactory light.

Results with other fixatives.

Material mixed by other methods confirms the account just given.

Picro-sulphuric. Tangential sections and strips of epidermis were prepared from material fixed in picro-sulphuric. The staining was as for the alcoholic material and the preparations gave the same results. Absolutely no cell boundaries exist. The internuclear sheet more commonly appears finely granular rather

than reticular. Possibly this is due to a deeper staining of the nodal points. But the fine reticular structure comes out well in places, especially in the pore membranes. Discrete granules such as are found in mesenchyme cells are either entirely absent or are found only in very small number here and there.

Acetic acid. Pieces were fixed in glacial acetic for a few minutes (5-10) and then transferred to water. The dermal membrane was peeled and cut from the choanosome, and was then cleaned of the underlying sponge parenchyma which was picked away with forceps and needles. The pieces were then stained, some in methyl green, others in acetic carmine or in haemalum, and were mounted in glycerine. Preparations so made give results similar to the foregoing. But they are not as transparent as balsam preparations and do not disclose the detailed structure of the internuclear sheet.

Osmic acid. Pieces were fixed in one-half per cent osmic for (10-15) minutes, washed in running water, and hardened in Müller's fluid 12 hours. They were run up very gradually through the alcohols. Sections and strips were made, stained in haemalum, and mounted in balsam. The preparations very frequently exhibited interesting artefacts. At first sight an epithelium seemed to be marked out in the clearest way. Perfectly clear channels of considerable width cut up the surface layer into areas that were often polygonal. Examination with an immersion objective showed that these areas were not cells. They sometimes have nuclei and sometimes not, and the channels between the areas exhibit peculiarities in their course which clearly indicate them to be cracks. The whole appearance must be due to the cracking of the very delicate epidermal sheet. The fixative probably makes the sheet brittle, and it later cracks perhaps during the washing.

Sublimate. Pieces were fixed for a few minutes in saturated corrosive sublimate and washed in iodised 70 per cent alcohol in the usual way. Tangential sections and strips of epidermis were prepared and stained in haemalum and congo red. Such preparations frequently exhibit artefacts similar to those produced by osmic. The surface layer is broken up into thin and irregularly polygonal pieces that are widely separated by perfect-

ly clear channels. The latter are crossed in some places by a few slender protoplasmic filaments. Careful examination shows that the pieces are certainly not cells. Some are without nuclei, others with a nucleus or sometimes with two. They often include one or more large clear vacuole-like spaces. This appearance again is probably due to cracking of the epidermal layer, perhaps coupled with a violent coagulation set up by the sublimate. The appearance is certainly an artefact, although the pieces in many places look at first sight like cells.

Silver nitrate. Thin pieces were sliced off from the surface of a living sponge, and were fixed 5-10 minutes in one-twentieth per cent osmic acid. After thorough washing in distilled water, they were transfered to one per cent silver nitrate and exposed to direct sunlight 5-10 minutes (Hertwig's method). After washing and running up through the alcohols, strips of epidermis were peeled off and mounted in balsam. Tangenital sections were also made and mounted in balsam. As a control small hydromedusae were stained in the same way. The subumbrellar surface of the latter showed the usual polygonal network of distinct brown lines, marking out the epithelium cells. The method was employed several times on favorable days.

Stained in this way the surface of Stylotella frequently exhibits no lines that in any way suggest cell boundaries. But in places an appearance is got with a Zeiss D objective as if epithelium cells were marked out. Examination with an immersion objective shows that the appearance (fig. 4) is due to artefacts and not to the presence of epithelium cells. The facts may be summed up as follows. The network of lines is below the thin surface layer. The lines are no browner than other strands, viz., have the osmic and not the silver stain. In the meshes are irregular masses that are usually nucleated. The areas marked out by the lines may vary greatly in size. It is plain that such areas cannot be epithelium cells The appearance is probably caused by violent coagulation of mesenchyme cells and strands. Inter-cellular connectives and parts of cell bodies remain as the network of brown strands, while the cell bodies, contracted and torn loose from the connectives, remain as the irregular masses that lie in the meshes.

REGENERATION OF THE EPIDERMIS IN STYLOTELLA

A dermal membrane with normal epidermis soon regenerates over a cut surface. For the study of the process of regeneration, sections vertical to the surface are of little use. The method I have followed was to allow the regeneration to proceed a certain time, then to fix and harden the piece of sponge, and to cut from the superficial region a number of thick (100μ) tangential sections. For the fixation alcohol, picro-sulphuric and sublimate were employed. The piece was stained in toto with haemalum, and the sections with congo red. Paraffine and celloidin sections were chiefly used, but good preparations were sometimes made by slicing off free-hand the regenerating surface from the piece in alcohol, and at once staining and mounting the slices. Or the piece was fixed in glacial acetic, washed in water, and the regenerating surface sliced off. The sponge parenchyma was then picked away with needles and forceps from the surface layer, which was later stained and mounted in glycerine.

The original cut surface was made as smooth as possible, and all of it is included in the first few sections. These are mounted with the regenerating surface uppermost. Where the surface was part of the choanosome such preparations are too opaque for study. But where the surface was part of the transparent collenchyma, the sections offer fairly clear pictures. Much the best pictures of all are to be had from the new dermal membrane which develops across the cut ends of the larger canals. To obtain membrane of this kind I cut off oscular lobes about an inch below the apex, thus cutting the main efferent canals transversely. The open ends of the canals become closed in by the new membrane which extends out from the surrounding collenchyma across the aperture. The rate at which the canals become c'osed in may be gathered from the following record. The lobes were cut off at 9:30 a. m., the cut surface of each lobe showing several widely open canals. At 1:30 p. m., most of the canals were closed in by thin, collenchymatous membranes perforated in the center, like diaphragms. In the case of a few canals the membranes had completely closed the apertures. Within an hour or

two all of the membranes had completely formed and the canals were entirely closed in. In fig. 5 one of the newly formed membranes, *c. m.*, with surrounding collenchyma and outlying choanosome is shown.

When the cut is first made, the dermal membrane covering the rest of the sponge ends at the exposed surface with a sharp edge. On the cut surface itself are exposed in choanosomal regions, flagellated chambers, mesenchyme, and spicules; in the regions immediately round the larger canals, only collenchymatous mesenchyme. The mesenchyme everywhere includes branched cells freely interconnected, and free amoebocytes. The latter are scarce in the collenchyma. Collenchymatous mesenchyme is especially characterized, it will be remembered, by the large amount of watery intercellular substance and the considerable length of the cell processes. A recognisable new dermal membrane develops over the whole surface within a day. The edge of the old membrane remains distinguishable for some hours, but it applies itself closely to the more solid sponge tissue, sinking in to meet the latter where it had covered subdermal spaces, and after about 12 hours it is no longer recognisable. By this time it is in perfect continuity with the layers of mesenchyme cells stretching over the cut surface and which are developing into the new dermal membrane.

We may now proceed to the detailed examination, by stages, of the developing dermal membrane and epidermis, using for study as explained above the membranes that develop across the open ends of canals and over collenchymatous regions.

One hour after cutting. The cut surface is occupied by branched cells containing abundant and conspicuous granules. Even in a comparatively small area they exhibit slight differences of level. These cells are interconnected so as to form a fairly close network. Some very small spheroidal cells, probably metamorphosed collar cells, lie free here and there. Many of the superficial granular cells are thin and flattened. Below the superficial cells lie several layers of essentially similar granular cells which are not flattened. They are interconnected with one another and

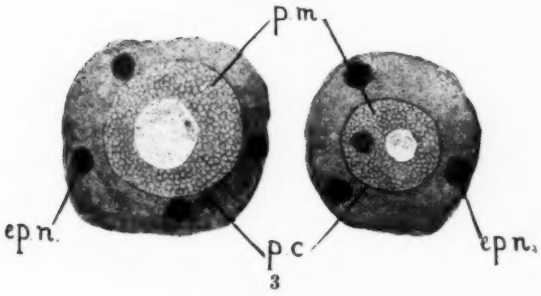
with the superficial cells. The entire network formed by the granular mesenchymal cells is closest at the cut surface and becomes more and open as we go deeper below the surface.

Two hours after cutting. The cells at the surface are now more uniformly flattened than they were an hour earlier. A group of the superficial cells is shown in fig. 6.

Five hours after Cutting. The surface is now occupied by a layer of thin, flattened, coarsely granular cells or cell areas connected by a complex network of fine intercellular strands (fig. 7). The cells areas are mostly uninucleate but may include two or even three nuclei. The areas have no precise boundaries but merge gradually into the intercellular network. On focussing below the surface layer, coarsely granular mesenchymal cells come into the view. These have slender processes and are freely interconnected forming a coarse open network (fig. 8, *m. c.*) This open network of coarsely granular mesenchymal cells constitutes the body of the developing dermal membrane. In it spaces which doubtless represent pore canals have already appeared. One such is shown in fig. 8 (*p. c.*) The mesenchyme cells bounding it, and which doubtless become the lining epithelium, do not yet form a continuous wall. Above the developing pore canal the epidermal layer, *p. m.*, is shown as it appears at the upper focus.

Twelve hours after cutting. The surface is now occupied by a continuous epidermal membrane in which the cells that have fused are still distinguishable (fig. 9). The area around each nucleus or group of two or three takes a deeper stain and appears as a finely granular, vaguely delimited area containing a good many of the coarse granules that characterise the fusing cells in earlier stages. Between these areas the epidermal membrane is a thin continuous sheet which in places appears reticular (alveolar) and in other places more fibrillar. In this thin sheet one sees here and there a few of the coarse granules which seem to be lodged, in cases at least, at the nodes of the reticulum. The sheet exhibits small perforations of varying size, sometimes twice as large as that shown in fig. 9 (*per.*) Possibly these are the beginnings of pores, although I was not able to observe that they always lay

PLATE II.



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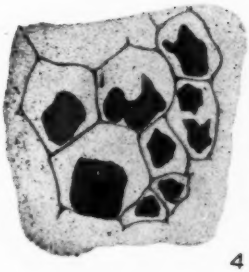
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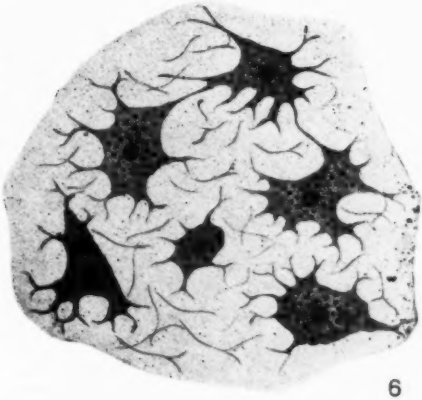
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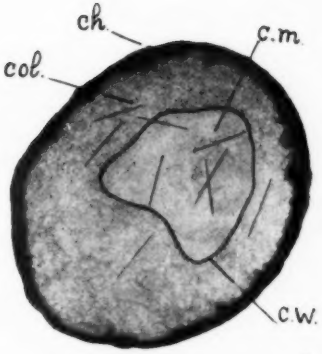

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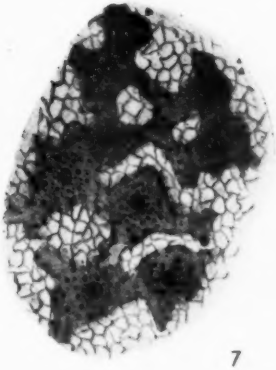
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over pore canals. In a regenerating dermal membrane at this stage groups of well formed pore canals are found here and there (fig. 9, *p. c.*) In the preparation shown in fig. 9, the pores are open.

Later development. The epidermis 24 hours after cutting is like that of the normal sponge. The course granules found in earlier stages are absent or present only in scanty number here and there. Pore canals that are open or closed in by pore membranes are abundantly present. The ectosomal skeleton is scanty. Pieces of sponge were kept in live boxes for a week and in these examination indicated that the ectosomal skeleton was practically like that of the normal sponge. The color of the new surface at this time was still like that of the interior, orange, while the old surface was orange with a distinct tinge of green.

Summary. A comparison of the stages just described shows that immediately after the cutting coarsely granular mesenchyme cells approach the exposed surface in considerable number. Many of the migrating cells are doubtless originally free amoebocytes. The granular cells when they have reached the neighborhood of the surface appear as branched bodies freely interconnected. This layer of interconnected granular cells develops into the new dermal membrane. The cells at the surface become flattened and more closely set than the deeper elements from which they are no doubt recruited during the first few hours. The fuse to form the epidermis. Union between the cells takes place not through crowding so as to give rise to plane surfaces, but through the continued development of intercellular connectives. As these become more numerous and branched they give rise to a complex reticulum of protoplasmic strands. This intercellular reticulum becomes transformed into what we would usually speak of as a continuous sheet of protoplasm, although careful examination shows that even in the adult it has a finely reticular, possibly alveolar structure. During the metamorphosis of the superficial granular cells into the epidermis, the cells loose their characteristic granules. The pore canals arise as excavations in the mesenchyme of the developing dermal membrane, and are covered in by the new epidermis which in such places constitutes pore membranes.

THE EPIDERMIS IN RENIERA

The species used is an undescribed one fairly common in Beaufort harbor. The body, frequently about 100 mm. high, is a complex system of anastomosing cylindrical branches, the diameter of which varies from 3 mm. to 8 mm. The color is often pink but varies to a brown. The oscula terminate short tubes arising vertically from the branches. Such oscular tubes are frequently 1.5–3 mm. in diameter, 2–4 mm. high. The wall of the tube is colorless, thin, and transparent. The sponge, like the other two forms used for the observations recorded in this paper, falls in the halichondrine monaxonida.

For the study of the epidermis pieces were fixed in absolute alcohol, 95 per cent alcohol, sublimate, picro-sulphuric. Thick tangential sections were made from the smoothest and most transparent parts of the surface. Both celloidin and paraffine were employed. Useful preparations were also made directly from the oscular tubes in the following way: The tube was cut off, split lengthwise, the sponge tissue picked away from the canalar surface, and the pieces mounted with the epidermal surface uppermost. For staining I made use in general of haemalum and congo red, staining the piece in toto with haemalum and the sections in congo.

Results with material fixed in alcohol

Alcohol proved much the best fixative. The epidermis is so delicate a membrane that during the treatment necessary with other fixatives it cracks. In the alcoholic preparations clean places must be looked for. These are abundant enough, and in such places the structure of the layer may be successfully studied. There are no cell boundaries. The layer is a syncytium as in Stylotella, consisting of a thin, continuous sheet of protoplasm containing abundant nuclei that are irregularly scattered (fig. 11). Round each nucleus as a rule the protoplasmic sheet is thicker than elsewhere, takes a deeper stain, and presents a finely granular appearance. The rest of the sheet is minutely reticular. Granules sufficiently large to be recognised individually and which are abundantly present in mesenchyme cells, are not found in the epidermis

The recticular character of the sheet is very distinct in places where the staining is both deep and clean. The meshes appear to be actual spaces. They look clear and empty and are bounded by the stained reticular lines. The thin pore membranes closing in pore canals are especially favorable for such observations. The epidermal sheet is certainly of surprising delicacy and thinness. It may often be traced over the large spicules which lie horizontally and form the superficial meshes of the skeletal network. In such places it rests upon the white background of the spicule and the reticular character comes out distinctly. There are places where mesenchyme cells of the dermal membrane also lie on top of the superficial spicules. But it is where the epidermis alone crosses the spicule that the opportunity for study is so especially good.

Results with other methods

Sublimate was given a good trial as a fixative. The epidermis cracks a great deal. The fragments are sometimes fit for study. They exhibit the reticular character of the sheet and an absence of cell boundaries, as noted above.

Picro-sulphuric which is a good fixative for the epidermis in Stylotella does not give good results on Reniera. The epidermis cracks into pieces. When treated with this fluid the membrane seems to have no stiffness. Thus it often drops down into the pore canals and breaks away from the part left on the surface. The fragments are sometimes fit for study. They are frequently polynucleate but exhibit no cell boundaries. The reticular character of the sheet could not be observed on this material.

Several trials of the silver nitrate method were made on favorable days. The silver entirely failed to show the presence of cell boundaries in the epidermis. Where the stain is deep, the outlines of mesenchyme cells and processes sometimes appear. The silver was used according to the method already described for Stylotella. Oscular tubes that had been so stained were split and mounted in water, glycerine, and balsam. Tangential sections were also made. As a control pieces of an expanded Leptogorgia

were used, and the epithelial cells on the surface of the polyps were here outlined with great distinctness.

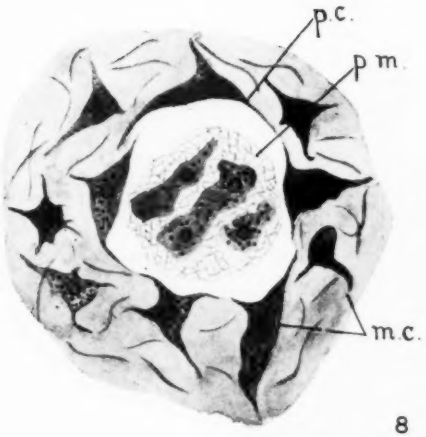
Pores, pore canals, and pore membranes

In the preparations made from preserved material, the pores are sometimes wide open or partially, sometimes completely, closed by pore membranes. The pore membrane as in Stylotella is simply an extension of the epidermis. When it incompletely closes the pore it has a single nucleus (fig. 11), and even when it is complete it may have but one (fig. 11). Frequently, however, when it is complete it exhibits more than one nucleus (fig. 11, *b*). As long as the pore membrane is imperfect the outline of the pore canal is distinct. When the pores are completely closed, however, it often happens that the outline of the pore canal is vague or lacking at some part of the circumference (fig. 11). The explanation of this appearance must be that after the epidermis has extended over the pore canal the mesenchyme of the dermal membrane also extends in towards the middle of the canal, thus tending to obliterate it.

Fortunately in this sponge the behavior of the pores may easily be watched during life. For this purpose an oscular tube is cut off, split lengthwise, and the halves mounted with epidermal surface uppermost in plenty of sea water under a coverglass. The cover flattens the pieces sufficiently to permit the use of a one-sixth inch objective. In such preparations made from a sponge just removed from the live box, many of the pores will be found open and their closure may be actually observed. I append the following records of observations on the closure of selected pores.

Pore 1. At 9.45 a. m., the pore is open with one nucleus at the margin (fig. 10). The nucleus shifts its position, traveling back and forth along the margin, going sometimes half round the pore and back again. The movements of the nucleus are quick and easily observed. At 9.50 the epidermis extends a short distance over the margin in the shape of a thin film. This gradually spreads across the pore becoming a well marked pore membrane. As it spreads the originally marginal nucleus passes into it. The sketches (fig. 10) show successive stages in the passage of the

PLATE III.



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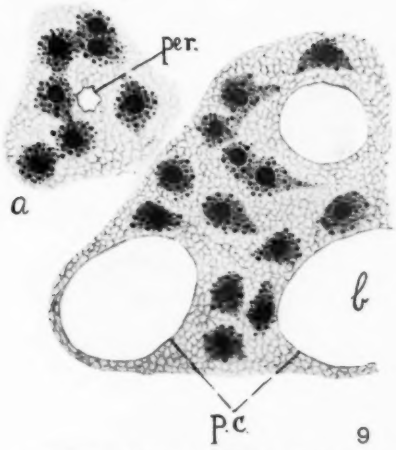

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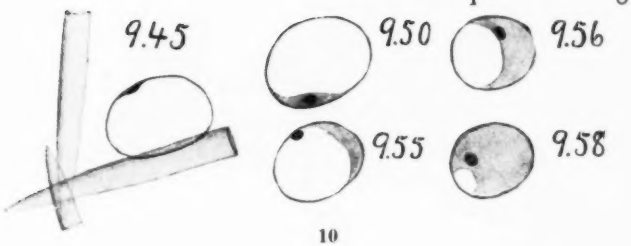

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membrane across the pore. At 9.58 the pore canal is almost completely closed in. Its outline is still distinct at this time. Five minutes later the pore is completely closed, and the outline of the pore canal is no longer distinguishable.

Pore 2. The pore at 10 a. m., is partly closed by a few interconnected strands of protoplasm which include a nucleus (fig. 12). The strands are thin and delicate, and are in continuity with the surrounding epidermis. The protoplasmic strands change form and arrangement, and the nucleus shifts its position, all very quickly. Such amoeboid movements continue for some minutes. During their progress camera sketches were made, and the conditions at 10.05 and 10.07 are shown in fig. 12. By 10.10 the protoplasmic strands have taken the shape of a marginal film. This is drawn into the epidermis, the nucleus remaining at the margin of the pore, and at 10.12 there is only the usual appearance of an an open pore. The nucleus now shifts quickly back and forth along the margin of the pore, narrow marginal films appearing and disappearing as the nucleus changes position (comp. sketches drawn at 10.15, 10.17, 10.20, fig. 12). The narrow marginal film present at 10.20 begins to spread at 10.21 and rapidly covers the whole pore, becoming a pore membrane into which the nucleus passes. Two stages in the completion of the pore membrane are drawn as they appear at 10.23 and 10.25. The pore is completely closed by 10.27. The wall of the pore canal was distinct all round until 10.21. Shortly after that time it began to grow indistinct round a part of the circumference (right side). At 10.25 it was no longer distinguishable in this region and was only vaguely outlined on the opposite side. The pore canal was kept under observation until 10.40 a. m. At that time its outline (*p. c.* in fig. 13) was still vaguely distinguishable, although circumscribing a much smaller area than formerly.

Pore 3. When the observations began the pore canal (fig. 14, 1.45 p. m.) was far smaller than the normal. It had evidently already contracted. It was partly covered by a pore membrane at the margin of which lay a nucleus. The marginal pore membrane was then largely drawn into the epidermis, the nucleus

shifting its position in what remained (comp. sketches drawn at 1.50 and 1.53). At 1.53 the marginal membrane began to spread rapidly, closing in the pore by 1.57. After complete closure of the pore the outline of the pore canal was still distinguishable. The outline was distinguishable but smaller at 2 p. m. The wall at this time was far from sharp and appeared rough and granular, whereas before closure of the pore it was sharp and smooth. The rough outline at 2 p. m., probably indicates how far the mesenchymal jelly has spread towards the middle of the original pore canal.

Pore 4. The pore at 2.05 p. m., was wide open, and at the margin two nuclei were distinguishable (fig. 15, 2.05 p. m.) One nucleus, *a*, remains at rest, but the other nucleus, *b*, shifts its position back and forth in the usual way. It position at successive moments is shown in the camera sketches made at 2.07 and 2.10. Nucleus *b* is the pore nucleus, the movements of which are associated with the formation of the pore membrane. The other nucleus *a* is not especially concerned in the closure of the pore. At 2.12 the epidermis has just crept beyond the margin of the pore, carrying with it the nucleus *b*. By 2.15 the pore membrane has completely crossed the pore and the outline of the pore canal is indistinguishable.

Pore 5. At the beginning of the observations (fig. 16, 3.15 p. m.) the pore which is somewhat constricted is crossed by a single strand of protoplasm. The strand moves across the pore and incorporates the nucleus (3.20). The strand with the nucleus at its base now shifts its position across the pore back and forth, finally passing to the edge and becoming a marginal film (3.30). This quickly spreads over the pore in the usual way.

Pseudopodial activity at the pores

While making observations on the closure of pores, pseudopodial activity was occasionally observed at the margin of the pore and at the free margin of a partial pore membrane. In fig. 17 three pores are represented in which such activity is going on. In pore *b* the pseudopodia extend out from the incomplete pore membrane, in the other two cases from the margin of the pore itself. The fine

pseudopodia were thrown out, moved about quickly, often fused more or less with one another, sometimes combining to form a network (pore *c*). They then were partially or completely drawn in, but reappeared after a short interval. This remarkable phenomenon was observed in the case of the three pores shown during one-half hour, at the end of which period the pores were still wide open and the pseudopodial activity going on. At several other times I have noticed the formation of one or two flagellum-like pseudopods at the margin of open pores. Such pseudopods would quickly appear, move or wave from side to side, and be drawn in. There was nothing to indicate that this pseudopodial activity at the margin of pores was a pathological phenomenon. It is possible that it occurs commonly during life, and that the pseudopodia are temporary, sensory processes which explore, so to speak, the region of the open aperture. The facts afford a further illustration of the widespread occurrence of "filose phenomena," to the importance of which as an expression of the fundamental nature of protoplasm, Professor and Mrs. E. A. Andrews have repeatedly called attention (see especially, Andrews G. F., '97).

Summary account of pore closure in Reniera

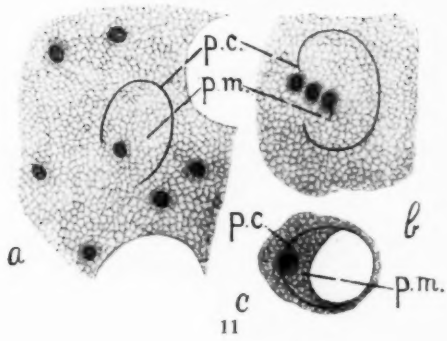
The pore canals may undoubtedly contract, viz., while still open become smaller (comp. figs. 15 and 16). The entire thickness of the dermal membrane shares in this process. Actual closure is, however, brought about by an extension of the epidermal layer across the pore. This extension of the epidermis may at once constitute a simple and continuous pore membrane (fig. 10) similar to that present in Stylotella. Or the epidermis may first extend across the pore in the shape of one or more strands of protoplasm which shift about in amœboid fashion (figs. 12 and 16) and are then withdrawn into the general layer before the continuous pore membrane finally begins to extend across the pore. A single nucleus not differing in appearance from other epidermal nuclei is associated with the closure of a pore. It lies at the margin round which it is shifted back and forth, in the first stage of closure, probably by wave-like movements of the pro-

toplasm similar in some respects to those occurring in plant cells (Nitella, *e. g.*) These movements of the nucleus are quick and easily observed. For instance a nucleus made the complete circuit of a widely open pore in about one minute. After closure of the pore, other nuclei beside the pore nucleus may pass into the area which covers the pore canal (fig. 11). The constant presence of a nucleus at the pore and its quick changes of position strongly suggest that it is in some way physiologically concerned in pore closure.

The extension of the epidermis to form a pore membrane does not necessari'y involve the rest of the dermal membrane, and hence after the epidermis has spread across the pore, the pore canal may still remain open, in which case its outline is distinguishable on focussing below the surface. Usually after closure of the pore, the outline of the canal is suddenly lost to view. This must be due to centripetal streaming of the mesenchyme of the dermal membrane, induced by some local contraction in the epithelial wall of the canal. Perhaps in nature the pores commonly remain in this condition until they reopen. At any rate this is the state in which closed pores are usually found in preserved material (fig. 11). In excised pieces of sponge kept under a cover glass the pore canal may completely or almost completely disappear. In this latter case the area of the canal diminishes greatly in size and its outline becomes rough and vague (figs. 13 and 14). This small and vaguely outlined area represents the central region of a pore membrane, and indicates how far the mesenchyme of the dermal membrane has streamed inwards in its obliteration of the pore canal.

The formation of a pore membrane is a contraction phenomenon which involves only the epidermis. The closure of the pore canal is probably also primarily a contraction phenomenon, which in this case involves the epithelial lining of the pore canal. The epithelial lining contracts, we may suppose, after the fashion of a sphincter, locally or throughout the extent of the pore canal, and so tends to obliterate the lumen. Such contraction brings with it a centripetal streaming of the mesenchyme of the dermal membrane. The closure of the canal is certainly not brought about by

PLATE IV.



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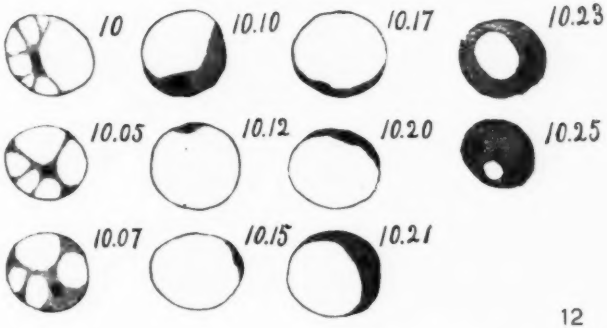

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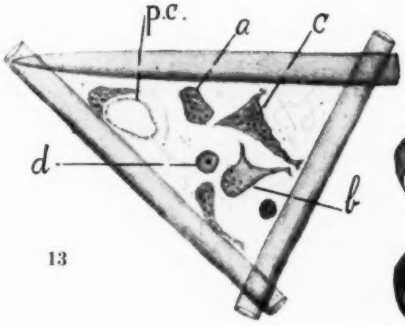

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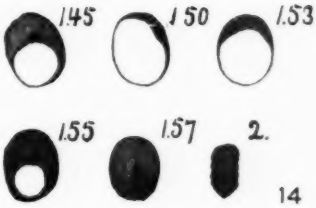

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the contraction of surrounding fibre-like cells arranged in sphincter fashion. There are none of these.

In the centripetal streaming of the dermal mesenchyme we must distinguish active movements of cells and passive movements of intercellular jelly. Both undoubtedly occur. On the active movements of such cells I may record the following few observations. The conspicuous cells in the mesenchyme of the dermal membrane are coarsely granular amoebocytes (cells *a*, *c*, in fig. 13) and pale cells either without coarse granules or with only a few (cells *d*, *b*, in fig 13). Both varieties of cells may appear in the spheroidal shape. When they are actively moving they are irregular in shape, the body extending out into slender prolongations. Cells of both varieties constantly shift their position, and undergo changes of form, all very slowly. The granular amoebocytes move more actively than the pale cells. The cells *a* and *c* crossed the space included between the spicules, passing over *b* which they obscured for a time. In crossing the space, cell *a* consumed five minutes.

CLOSURE OF PORES IN LISSOCENDORYX

The species used was Lissodendoryx carolinensis, a common form in Beaufort harbor, and a description of which is contained in a paper now in press for the U. S. Bureau of Fisheries. The sponge falls in the halichondrine monaxonida. The whole surface is abundantly covered with tubular translucent papillae the walls of which are perforated with numerous pores. These pore-papillae which are often slightly branched are contractile and may almost entirely disappear. When dilated they are about 3-5 mm. long and 1 mm. in diameter.

If such pore-papillae in the expanded state are cut off and mounted in sea water, many pores are found to be open, and their closure may be watched under the microscope. Each pore lies in a field surrounded by long spicules (tylotes) and when expanded is large. As in the cases of the preceding species, I restrict the term pore to the actual aperture of the surface, using the term pore canal for the very short tube which perforates the wall of the

pore-papilla. I append the following record of observations on the closure of selected pores.

Pore 1. When the observations began at 2.25 p. m., the pore canal and pore were wide open. The pore canal steadily contracts until 3.20 p. m. The diameter of the canal at this time is about one-third of the original size. While the pore canal is contracting, the surrounding spicules come closer together (the whole papilla contracts). The mesenchyme cells at 3.20 extend to the very wall of the pore canal. Immediately after 3.20, a thin homogeneous looking membrane containing no mesenchyme elements suddenly extends out across the open aperture. This pore membrane (fig. 18, 3.25 p. m.) in a few minutes time closes the pore completely.

Pore 2. The pore canal at 3.30 p. m. had already contracted to about one-half the full size, and was in the same condition as pore 1 at 3.20 The pore, however, closes in a different way from pore 1. The canal steadily contracts until it disappears, at 3.40 p. m.

Pore 3. The pore canal contracts to about one-half its original diameter. It then is found covered in near its margin by an extension of the dermal membrane. This extension constitutes zone *b* of fig. 19. From this zone a further extension in the shape of a very thin membrane, zone *a*, formed exclusively by the epidermis, extends over the more central part of the canal. It seems proper to designate zone *a* as a pore membrane. My record for this pore is not complete. Probably the pore membrane was first formed, and the mesenchyme of the dermal membrane later streamed inwards, forming zone *b*. The pore membrane soon closes the pore completely. The distinction between zones *b* and *a* is later lost, since granular amoebocytes and microscleres invade zone *a*. Even after this has occurred, on focussing below the surface, the wall of the pore canal may be seen.

Summary. In this sponge the pores do not always close in the same way. (1) Often the whole pore canal closes up and disappears by simple contraction. Pore 2 closes in this way. (2) In other cases the pore canal shrinks as before, but actual closure

is brought about by a rapid extension of the epidermal layer across the pore, forming a pore membrane (pore 1.) (3) In still other cases the pore canal shrinks and closure is then effected through the formation of a pore membrane which is gradually reinforced by the dermal mesenchyme (pore 3).

COMPARISON OF THE METHODS OF PORE CLOSURE AS OBSERVED IN STYLOTELLA, RENIERA AND LISSODENDORYX

The various ways in which pores were observed to close in the three species of sponges that were studied may be arranged in a series expressing the successive physiological states that conceivably may occur in the closure of a dermal pore in monaxonid sponges generally. (1) A partial closure of the pore may be brought about by the extension of the epidermis across the aperture in the shape of one or more amoeboid strands of protoplasm (figs. 12 earlier stages, and 16, for Reniera). Possibly this state is sometimes preceded by the formation of fine pseudopodia at the margin of the pore (fig. 17, for Reniera). Such closure is temporary. The pore opens and then remains open or (2) is completely closed by a continuous extension of the epidermis across it, forming a pore membrane (fig. 12 later stages, for Reniera; figs 2 and 3 for Stylotella). (3) To bring about a more secure closure of the pore, the pore membrane is reinforced by a centripetal extension of the dermal mesenchyme induced through contraction of the epithelial lining of the pore canal. This reinforcement extends gradually from the margin across the whole pore (fig. 19 and pore 3, for Lissodendoryx). (4) Hitherto the lower part of the pore canal, opening into the subdermal chamber, has remained open. Contraction accompanied by centripetal streaming of the dermal mesenchyme now affects this part of the canal and almost obliterates it (fig. 13, for Reniera) or completely obliterates it (pores 1 and 4, for Reniera).

The final result, complete closure and obliteration of the pore canal, which may occur as the end of a series of easily distinguished steps, is in other cases brought about simply through

continued shrinking (pore 2, for Lissodendoryx). Or the pore canal may shrink greatly, and then be closed in by the formation of a pore membrane (fig. 18, for Lissodendoryx,) the complete obliteration occurring later.

THE CANAL EPITHELIUM IN STYLOTELLA

Osculer lobes of sponges in which the canals were well expanded, were fixed in alcohol (absolute and 95 per cent,) sublimate, and picro-sulphuric. After hardening pieces were excised which included two or three of the main efferent canals, and these were sectioned so as to cut the canals longitudinally. Celloidin was used as an imbedding material, and the sections were cut thick. As the series of sections passes through a canal, the first and last sections will of course cut the canal wall tangentially, and these sections when mounted with the canalar face up give excellent surface views of the lining. For staining haemalum was used "in toto," and the sections were stained in congo red. It is only the main efferent canals that I have studied.

Pieces fixed in alcohol and picro-sulphuric yield essentially the same results. A study of the details show further that the results are reliable. The main efferent canals are lined with the epithelial membrane depicted in fig. 20. It may be seen that the membrane consists of a single layer of flattened cells that are separated by wide spaces across which abundant intercellular connectives pass. The cells are in general elongated in a direction transverse to the long axis of the canal, but polygonal cells also occur. The cytoplasm is granular and vacuolated, and quite without distinct boundaries. It passes insensibly into the intercellular connectives. The vacuoles vary in size and are irregularly distributed. In many cells the granules are scattered more or less uniformly through the cell, but quite commonly they are distributed in dense and pretty straight tracts which often extend along one margin. The nuclei appear to be all alike. They uniformly show the membrane, nucleoplasm, and chromatin in the shape of granules or short pieces (doubtless a reticulum exists).

The term "cell" and the idea expressed by it are not altogether appropriate to the nucleated areas present in this mem

brane. The areas are everywhere united by abundant intercellular connectives, and merge very gradually into these, the cytoplasm often thinning away into reticulated films which then pass into the intercellular strands. Where the margin of the cell area is densely granular, the distinction between cell and the connective is sharper (a figure inevitably represents the contrast between cell body and connective as sharper than it exists in nature). The nucleated areas are frequently directly confluent, so that one and the same area may contain two nuclei (fig. 20). The membrane is actually of course a syncytium, but it is one in which the component cells permanently remain in a state of imperfect union. The regenerating epidermis passes through an essentially similar stage (fig. 7). The canal lining thus remains in a condition not so far removed from the mesenchyme as is the epidermis. Like the epidermis it may be regenerated from the mesenchyme, probably as Weltner ('07) maintains, largely from the granular amoebocytes.

When the membrane is examined with a comparatively low power, the nucleated cell areas appear to have distinct boundaries and to be independent cells separated by wide spaces. Fixation with sublimate may lead to the same erroneous conclusion. In fig. 21 the canal epithelium is represented as it appears when prepared from sublimate material. The cells are widely separated and have good sharp boundaries. The cytoplasm is finely granular and fairly dense. Almost no intercellular connectives are present. The absence of the connectives and the uniform dense granular appearance of the cells when comparison is made with a good alcoholic preparation such as that from which fig. 20 was made, must be regarded as artefacts due to the sublimate treatment.

There is good indication that the lining epithelial cells are contractile and of themselves bring about the diminution in bore of the canal. The canals certainly do diminish in bore, and greatly at times. Round the canal there are no fibre-like mesenchyme cells arranged sphincter fashion. But the shape and arrangement of the lining epithelial cells suggests plainly that

they are the closers of the canal. As I have said the cells lining an expanded canal are in general elongated transversely to the long axis of the canal. Very often the cell is so long and narrow that it is properly described as fibre-like (figs. 20 and 21). Mingled with such one finds other cells that are not greatly elongated and still others that are polygonal (fig. 21). I have examined some canals in which contraction had very materially diminished the size of the lumen. In these I found that a very large number of cells were either only moderately elongated or were polygonal. This is what one would expect to find if the epithelial cells do by contraction shorten and so tend to close up the canal.

In this connection it may be noted that in the case of contracted canals, when seen in cross section, the surrounding mesenchyme (collenchyma) cells are found to be greatly elongated and arranged in such fashion that they radiate outwards from the canal wall. The appearances suggest that as the epithelial cells are the closers of the canal, the surrounding collenchymal cells act as openers.

COMPARISON

It is well known that in a large number of sponges the dermal surface is covered and the canals lined with a single layer of cells (pinacocytes of Sollas) forming an epithelium. It was F. E. Schulze who in 1875 first established this fact. After demonstrating the presence of epithelia in Sycandra he showed in succeeding numbers of his classical "Untersuchungen" that the same or very similar structural conditions are found in a great variety of sponges. Schulze's conclusions have been confirmed and extended, for the same and other forms, by many observers. A review of the literature shows, however, that both Schulze and other observers have now and then, in this sponge or that, been unable to demonstrate the presence of distinct cells in the epidermal membrane. Possibly in some of these forms the epidermis is a continuous syncytium as in Stylotella and Reniera. With regard to the canal lining a number of recorded facts suggest that loose epithelioid membranes such as I have found in Stylotella perhaps occur with some frequency in place of typical epithelia

composed of polygonal cells fitting together neatly by straight edges. The covering layers of surfaces exposed to the water are certainly less uniform in sponges than was supposed some years ago to be the case. The hexactinellids in particular depart from the common condition. In these sponges, as Ijima's important discoveries seem to show, the covering layers in question can not be regarded as epithelia at all.

In the following sponges the occurrence of epithelia on the surface of the body, or lining the canals, or in both situations, is well established.

Calcarea. In Sycandra (Schulze '75) the dermal and gastral surfaces are covered with an epithelium composed of a single layer of flat polygonal cells which fit together neatly. In Grantia according to Dendy ('91 a) the epidermis is a simple flat epithelium and the inhalent canal system is lined with a similar layer. In Vosmaeropsis too, Dendy ('93) finds that the epidermis and canalar lining are simple flat epithelia. In Clathrina, Minchin ('00) finds the dermal surface covered with flat polygonal epithelium cells, between which are intercalated the peculiar pore cells. In Leucosolenia, Dendy ('91 b) finds the dermal surface covered with thin flat polygonal epithelium cells. The more recent investigations of Urban ('06) show that while the flat cell is the common type, the epidermis also includes cells of other shapes, some cylindrical, some flask-shaped, the later probably glandular. Minchin '08 confirms Urban's account as to the variation in shape of the epidermal cells in this genus.

Carnosa. In Chondrosia and Chondrilla (Schulze '77b) the canals are lined with a simple flat epithelium. In Plakina (Schulze '80) the dermal surface and canals are covered with a single layer of flat epithelium cells that are flagellated. In Plakortis (Schulze, loc. cit.) the conditions are similar except that the cells are probably not flagellated. In Corticium, Schulze ('81) finds that the dermal surface is covered with flat epithelium cells. The canals of this genus are lined in places, according to Lendenfeld ('94, p. 71) with columnar epithelium.

Tetractinellida. In Craniella and some others of the "Challenger" tetractinellids Sollas was able to distinguish epithelial

cells. He does not state whether the cells in these cases were epidermal or canalar ('88, p. 36.) In Geodia and Ancorina Lendenfeld finds ['94, p. 74] that the canals are lined in places with massive cells.

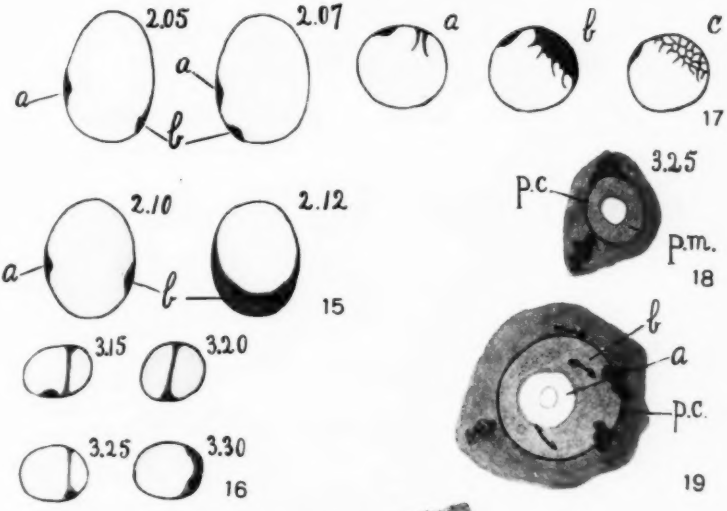
Monaxonida. Among the Clavulina Lendenfeld finds ('96) in Tethya, Suberites, and Polymastia that the epidermis consists of flat epithelium cells. In Vioa, Suberanthus, Astromimus, and Papillella he finds the canals lined with epithelium cells which in some cases are flat, in others high, the two varieties perhaps only representing different physiological states of the same elements. In Suberites, Thomson ('86) observed that the epidermis consisted of a single layer of small, polygonal, and apparently unequal cells. Among the halichondrine monaxonida the Spongillidae are perhaps the best known. In these sponges (Ephydatia) Weltner ('96, '07) finds the epidermis and canal lining made up of flat epithelium cells (pinacocytes). Delage and Hérouard describe (99, p. 176) the same condition as obtaining in Spongilla. According to Weltner the epidermal cells include the pores which would therefore be intracellular.

Keratosa. In Aplysina (Schulze '78 a) the dermal surface and canals are covered with flat epithelium cells. In Spongelia (Schulze '78 b) the same condition occurs. In Euspongia and Hircinia (Schulze '79 a, b) the canals are lined with flat epithelium. In Aplysilla (Schulze '78 a, Lendenfeld '89) the epidermis and canalar lining are made up of flat cells. In Dendrilla and Halme Lendenfeld ('89) finds that epidermis and canalar lining are made up of flat epithelium cells that are flagellate. In Ianthella (Lendenfeld '89) the epidermis consists of flat cells.

Myxospongida. In Oscarella lobularis (Schulze '77 a) the dermal surface is covered with a single layer of fairly thick cells that are flagellate, and the canals are lined with a similar layer. In Halisarca Dujardini (Schulze '77 a) the canals are lined with flat simple epithelium.

In the Hexactinellida true epithelia appear not to be present either on the surface or lining the canals. A thin nucleated protoplasmic layer, to be sure, has been known since F. E. Schulze's examination of the "Challenger" collections ('87) to occur on the

PLATE V.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2.07
a
b
a
b
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17
3.25
p.c.
p.m.
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3.15
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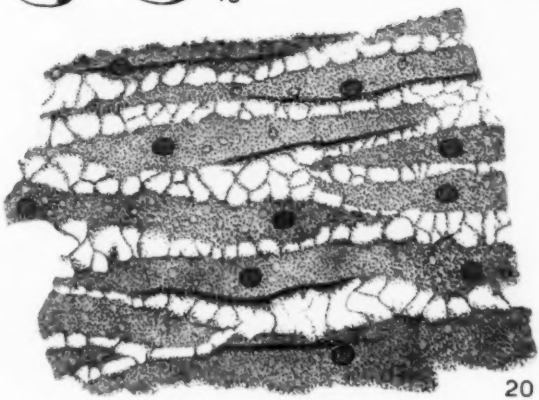
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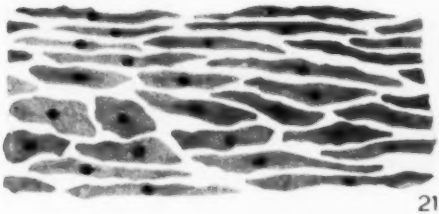
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dermal and canalar surfaces in many of these sponges. Schulze regarded the layer as an epithelium, stating however, that he was not able to detect the contours of the cells. Ijima ('01, '04) finds that such membranes do not consist of differentiated epithelial cells distinct from the underlying trabecular tissue (essentially a plexus-like syncytium of mesenchyme elements), but are produced simply by the flattening out of the superficial trabeculae. In some cases there is really no bounding membrane, since the general syncytium preserves at the surface its character as a reticulum. Schulze is inclined ('04, p. 202) to assent to Ijima's position and remarks "Es ist also wohl anzunehmen dass hier" (in the hexactinellids) "die Differenzierung der oberflächlich liegenden Gewebszellen zu echten epithelialen Pinakocyten unterblieben ist." The permanent condition of a hexactinellid would thus seem not to be far removed from that of a monactinellid (Stylotella) which is in process of regenerating its epidermis. Rarely it may happen that monactinellids linger permanently at this low stage of histological development. Suberanthus as recorded by Lendenfield (96, p. 172) seems to be a case in point:

"Bei Suberanthus flavus ist die äusserste Gewebelage aus einer dichten, vielschichtigen Lage von unregelmässigen, massigen, multipolaren Zellen zusammengesetzed. Die äussersten von diesen sind auf der Aussenseite abgeflacht und bilden das äussere Epithel, unterschieden sich aber sonst in keiner Hinsicht von den tiefer liegenden."

In the following sponges the records leave it uncertain what is the structure of the epidermis. In Chondrosia and Chondrilla (Schulze '77, pp. 18, 20, 23, 27) an epithelium does not occur on the dermal surface, which is covered with a thin, finely fibrous or homogenous cuticular layer that is possibly formed by the fusion and metamorphosis of cells. In Euspongia (Schulze '79 a, p. 626) it is uncertain whether the epidermis is composed of distinct cells. In Hircinia (Schulze 79 b, p. 16) the structure of the epidermis is uncertain. Some observations would indicate the presence of distinct cells, others that no cell boundaries exist. In Halisarca Dujardini (Schulze '77 a, p. 38) the dermal surface is covered with a peculiar layer, cuticular in appearance, probably

formed by fusion of epithelial cells that undergo a gelatinizing metamorphosis.

The case of Reniera. In Reniera aquaeductus Metschnikoff ('76) thought that he was able with silver nitrate to demonstrate clearly cell contours in the epidermis. Keller a little later ('78) studied the histology of Reniera and found that the silver method did give him a well marked system of dark lines forming polygonal meshes. But in many meshes no nuclei were present, while in others they lay in the extreme corner of the mesh, or again, they often lay directly upon the lines. For these and other reasons Keller believed that the meshes did not represent epithelial cells but were to be looked on as artefacts. I agree with Keller in this interpretation. Keller watched the closing of pores in living preparations under the microscope, but does not mention any structure such as the pore membranes of this paper He is perfectly right in discrediting the idea that the pores are closed by the contraction of surrounding muscle-like cells, and is substantially in the right in maintaining that the pores open and close through the movements (contraction) of a superficial layer. As to the nature of this layer Keller at that time followed Haeckel and believed that the outer part of the sponge body (what is usually called epidermis or ectoderm plus mesenchyme or mesoderm) is composed of a soft living sarcode (exoderm of Haeckel) in which certain structures, spicules and some cells, are imbedded. This conception became untenable with the publication of F. E. Schulze's "Untersuchungen" (1875-81).

Nature of pores. In the Calcarea specialized pore cells, porocytes, are described, the pore being a perforation of such a cell and therefore intracellular. The porocytes lie at the surface of the simpler olynthus-like forms (Clathrina), but in the more complex Heterocoela they are said to occupy a position in the walls of the flagellated chambers. The apertures at the surface of the Heterocoela, dermal pores, are usually thought of as intercellular gaps, *i. e.*, as apertures each of which is bounded by numerous cells of the epidermis (Minchin '00, pp. 27, 48). In the Monaxonida and other Demospongiae we find as in the Heterocoela, apertures at the surface of the body, dermal pores or ostia, and

apertures in the walls of the flagellated chambers, chamber pores or prosopyles. The accounts leave it uncertain as to whether the latter always have the same character (Minchin, loc. cit.) The assumption is usually made that the chamber pores are intercellular gaps. My own observations on this point are limited to the the tetractinellid genus Poecillastra (Wilson, '04, p. 107, pl 15, fig 2). The material seemed to be well preserved and in sections it could easily be seen that the collar cells were wide apart and rested upon a bounding membrane which connected them, and which itself showed no cell boundaries. The chamber pores appeared as perforations in this membrane. If we look on the membrane as formed of thin extensions from the bases of the collar cells, the chamber pores here are equivalent to intercellular gaps. On the other hand there are investigators who think the chamber pores may be intracellular structures. Thus Evans (99, p. 419, figs. 32, 33, 34) is inclined to believe from his observations on Spongilla that true porocytes exist in the walls of the chambers in this sponge.

In our ideas of the dermal pores too a certain vagueness prevails, which can only be cleared up by further investigations. The distinction between the actual aperture and the pore canal should it seems to me, be borne in mind, although where the dermal membrane is excessively thin it may be that such distinction is in practice impossible. Usually the dermal pores are thought of as perforations of the dermal membrane, the two layers of epithelium being continuous round the margin of the pore. Where cell boundaries exist in the epidermis, such a pore, *i. e.*, the actual aperture, would have the nature of an intercellular gap and would not differ in its fundamental structure from an osculum. I conceive the pores in Stylotella and Reniera to be of this nature. Were the epidermis in these sponges divided up into distinct cells, I take it that the pores (comp. figs. 1, 2, 3, 11) would each be surrounded by several cells. The observations of several investigators, however, have inclined them to believe that the dermal pores are intracellular structures, perforations of cells that are comparable to the porocytes of Calcarea. In the very young, recently metamorphosed Axinella, Maas ('93, p. 350, pl. 21, fig. 37) finds

that the surface views of all his preparations speak for this interpretation. If this idea be true, the porocyte occupies the thickness of the dermal membrane, extending from the outer surface to the subdermal cavity. Delage in describing the recently metamorphosed Spongilla ('92, p. 398, pl. 16), discusses whether the pores be intercellular gaps or intracellular structures, and thinks they are probably the latter. The relation of the porocyte, provided it exist, to the dermal membrane as a whole would here be problematical, since according to Delage, when the pores appear the mesenchyme and the inner epithelial layer of the dermal membrane have not developed. Weltner ('07, p. 276) too is led by his observations on Ephydatia to regard the dermal pores as intracellular. He speaks of them as perforations of the pinacocytes and mentions that the latter can change their shape. It is evident that a more extended, comparative study of the point is needed. It is not impossible that beneath the appearances recorded by the above named authors will be found the structural conditions described here for Stylotella and Reniera. In passing it may be noted that both Delage and Maas figure the epidermis as without cell boundaries.[3] If cell boundaries really exist, it is remarkable that they should not be visible in such thin membranes at a magnification of 750, the magnification at which Delage's figures are drawn.

Canal epithelium. The loose epithelioid membrane which I have found lining the canals of Stylotella cannot be an isolated structure. Several facts recorded in the literature indicate that it may possibly be a common type. From among these I may mention the following: Sollas ('88, p. xxxvi) describes the epithelium lining the cortical canals of Pachymatisma as "without definite cell outlines, but the contained protoplasm, however, is very admirably displayed, as a superficially extended film produced into innumerable fine, sometimes branching threads." The thread-like processes of adjacent cells seldom appear to unite, but terminate abruptly." The figure (pl. 34, fig. 22) given by Sollas indicates plainly that the canal lining in Pachymatisma is similar to that in Stylotella. Dendy ('93) finds that the cells of the canal

[3]Delage, loc. cit., pl. 16, fig. 9 b, for Spongilla; pl. 21, fig. 5, for Aplysilla. Maas, loc. cit., pl. 21, fig. 37, for Axinella.

epithelium in certain calcareous sponges, Grantessa, Sycon, Vosmaeropsis are sometimes separated from one another by wide intervals. He regards this appearance as due to contraction, the cells having pulled away from one another. They may still remain connected, he says, in places by strands of protoplasm. Some of Dendy's figures (pl. 14, figs. 60, 62, 64) suggest that in these sponges too the canal lining may be of the type found in Stylotella.

NOTE—I am fortunately able to refer to a publication by Professor G. H. Parker[4] that has appeared while the foregoing paper has been passing through the press. Parker, in the course of an interesting physiological study of Stylotella heliophila, one of the forms on which my observations were made, touches incidentally on the histology. Some of his conclusions differ from mine.

He thinks that the dermal epithelium is composed of polygonal cells. This conclusion rests on a study of sections which were apparently vertical to the surface and made from osmic material. The dermal layer is so thin that I do not believe it possible to learn much of its structure from such preparations. The same criticism applies to the conclusion that the dermal pores are surrounded by elongated spindle-shaped cells, myocytes, which act as sphincters. Surface preparations, such as those from which my figures were made, show that the pores are not surrounded by cells of this kind.

Parker finds that the canals are lined with flat epithelium. In addition an abundance of myocytes surround the canals (and oscula) arranged like sphincters. "In some places in my preparations they seem to lie directly on the exposed surfaces of the canals and cavities that they bound as though they were merely elongated epithelial cells" (loc. cit., p. 7). It is clear from this quotation that Parker has seen the same elongated epitheloid cells which I have described as lining the efferent canals. My precise observations were limited to these canals, but I may say that I doubt if both an epithelium and an outer sphincter-like layer of myocytes bound any of the canals. Round the osculum the case must be different. Parker here finds a well marked sphincter.

[4] G. H. Parker. The Reactions of Sponges, with a Consideration of the Origin of the Nervous System. Journal Exp. Zool., Vol. 8, 1910.

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EXPLANATION OF FIGURES

1 Stylotella. Dermal membrane over subdermal cavity—from thick tangenital section. *cc*, cells lining subdermal cavity; *ep.n.*, epidermal nuclei; *m.c.*, mesenchyme cells; *p.c.*, wall of pore canal; *p.m.*, pore membrane; *s.c.w.* wall of subdermal cavity. × (1200 Zeiss 2 mm., oc. 6).[5]

2 Stylotella. Dermal membrane perforated by pore canals—from thick tangential section. Pores closed. References as before. × 1200.

3 Stylotella. Dermal membrane perforated by pore canals—from thick tangential section. Pores partially closed. References as before. × 1200.

4 Stylotella. Dermal membrane showing osmic-silver artefacts. From thick tangential section. × 1200.

5 Stylotella. An oscular lobe was cut transversely. Part of cut surface is shown; canals have been closed in by newly formed membrane. *ch.*, choanosome; *col.*, collenchyma; *c.w.*, wall of canal; *c.m.*, newly formed membrane closing in the canal. × 85.

6 Stylotella. Regenerating epidermis. Exposed surface two hours after cutting. × 1200.

7 Stylotella. Regenerating epidermis. Exposed surface five hours after cutting. × 1200.

8 Stylotella. Regenerating epidermis. From tangential section of new

dermal membrane that has closed in a canal. Five hours after cutting. Body of figure is drawn at a focus below cut surface, and shows mesenchyme cells, *m.c.*; *p.c.*, space in mesenchyme, probably representing pore canal. At a different focus the epidermis, *p.m.*, is drawn where it roofs in the space. In such a position the epidermis presumably forms a (closed) pore membrane. × 1200.

9 Stylotella. Regenerating epidermis. Exposed surface twelve hours after cutting. Pore canals, *p.*, now perforate the dermal membrane; small perforations of the epidermis, *per.*, occur. × 1200.

10 Reniera. Successive stages in the closure of a pore. × 600 (Zeiss D 4).

11 Reniera. Epidermis from an oscular tube. Walls of pore canals, *p.c.*, shown at a lower focus. Pore canals partially or completely closed in by pore membranes, *p.m.* × 1200.

12 Reniera. Successive stages in the closure of a pore. × 600.

13 Reniera. Dermal surface.—from an oscular tube. *p.c.*, pore canal of fig. 12, now closed in and contracted; *a-d.*, cells in the mesenchyme. × 600.

14 Reniera. Successive stages in the closure of a pore. × 600.

15 Reniera. Successive stages in the closure of a pore. × 600.

16 Reniera. Successive stages in the closure of a pore. × 600.

17 Reniera. Three pores showing pseudopodial activity, at margin (*a*, *c*), or at margin of incomplete pore membrane (*b*). × 600.

18 Lissodendoryx. Late stage in the closure of a pore. *p.c.*, wall of pore canal; *p.m.*, pore membrane. × 600.

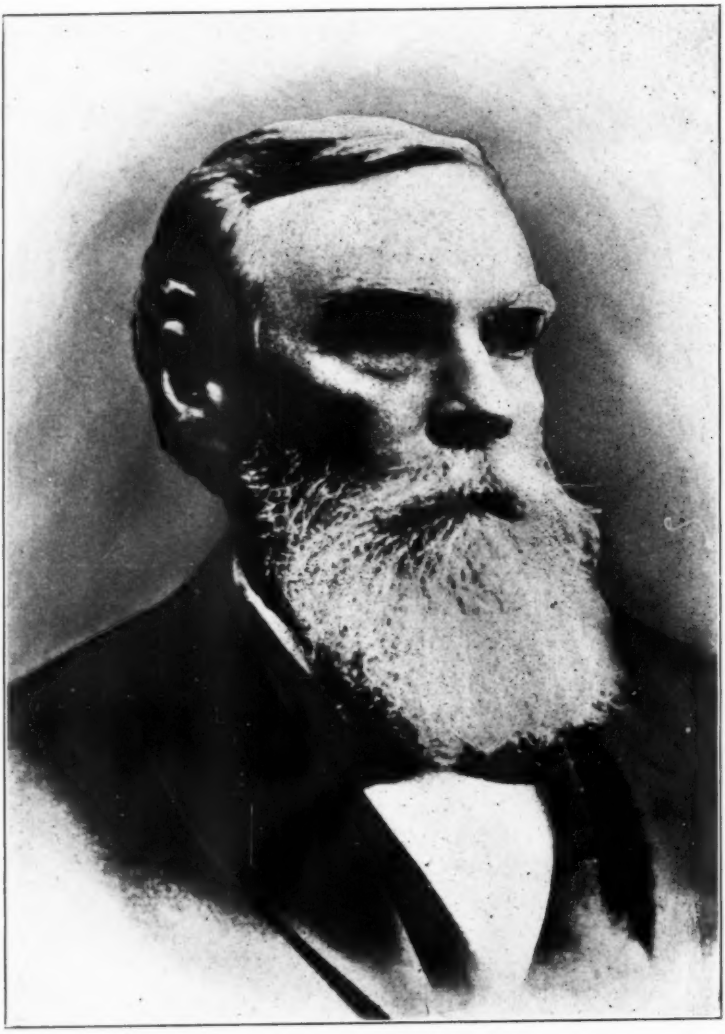
19 Lissodendoryx. Stage in the closure of a pore. × 600.

20 Stylotella. Epithelioid lining of main efferent canal. Alcohol fixation. × 1200.

21 Stylotella. Epithelioid lining of main efferent canal. Sublimate fixation. × 600.

[s]All figures have been reduced in reproduction by one third.

PLATE VI



JOSEPH HINSON MELLICHAMP
1829-1903.

DR. JOSEPH HINSON MELLICHAMP.

By W. C. Coker.

Dr. Joseph LeConte in his charming autobiography refers to the fact that while the civilization of the old South produced many men of fine scholarship and great capacity they seemed rarely to have any ambition for the notoriety that comes from publication. Such a man was Langdon Chevis, to whom Dr. LeConte refers, and such also was Joseph Hinson Mellichamp of Bluffton, S. C.

The life that Dr. Mellichamp led was as simple and beautiful as a child's. Though I never saw him I know so well the type to which he belonged—without ever a selfish thought or hope of fame he opened his mind to the inexhaustible inspirations of nature and transmuted them into a faith and love that warmed the hearts of all who knew him. He was one of those who gave the old South its real distinction, a distinction that rested not so much upon the material as upon the spiritual evidences of life.

Several little sketches have appeared that give the salient facts and "superficial vestments" of his days. These are by Dr. (S. C.) Sargent of the Arnold Arboretum in his "Silva of North America," volume on Cupuliferae, page 144; by Mr. Yates Snowden in the Charleston "News and Courier" of July 20th, 1897; by Mr. W. H. Canby, a well known botanist and banker of Wilmington, Delaware, in Torreya, Vol. 4. No. 1, Jan. 1904; and by Mr. W. P. Gee in the Charleston "News and Courier".

The most important of these is the appreciation by Mr. Canby who knew Dr. Mellichamp personally, and is referred to by him in one of the letters published herewith. I shall give this sketch in full for the light it throws on the character of Dr. Mellichamp. Mr. Canby says:

"Dr. Mellichamp—an excellent botanist of South Carolina—died on James Island in that State on the second of October last.

"Joseph Hinson Mellichamp, the son of the Rev. Stiles and Sarah Cromwell Mellichamp, was born in St. Luke's Parish, South Carolina, on the 9th of May 1829. His father was for many years Preceptor of Beaufort College and afterwards was pastor [rector] of St. James Church on James Island. Being a lover of outdoor life and of natural objects, he gave his son a taste for the same and especially for botany, which continued throughout his life. In 1849 he graduated from South Carolina College and in 1852 from the Medical College at Charleston. He then spent some time in Europe, studying at the Hospitals of Dublin and Paris. On his return he established himself as a physician at Bluffton, South Carolina, and he remained there the most of his life—the exceptions being the time when he was a surgeon in the army of the Confederate States and when, during his last years, much of his time was spent with his daughter and only child in New Orleans. It was during this period that, to his great delight, he accomplished a visit to California and its 'big trees.'

"Notwithstanding the diligence required to fulfil the responsibilities of a large practice among the planters and their dependents, he found time for much botanical research and collecting. In the interesting floral region around him were many of the rarer species described by Walter, Michaux, and Elliott. Specimens of these were much prized by the botanical fraternity and, through his correspondents, were largely and freely distributed and are now valued samples in many of the best herbaria.

"His good judgment in making observations and clear statements of the results brought him the correspondence and esteem of Doctors Gray, Engelmann, and other masters of the science. For Dr. Engelmann he investigated the flowering and fruiting of some species of Yucca, the peculiar oaks of his region, and especially Pinus Elliottii, which he practically discovered and, in the excellent notes he furnished, adequately described. Very acute observations on the insectivorous habits of Sarracenia variolaris were published in the Proceedings of the American Association for the Advancement of Science. In this paper he recorded

his discovery of the lure by which insects are tempted to the fatal pitcher of the leaf; of the fact that the secretion therein is more or less an intoxicant; and the curious fact that the larva of a certain insect was able to resist the secretion and to feed upon the decaying mass. Dr. Sargent, in his "Silva of North America," acknowledged his services in the studies of the oaks and other trees. Dr. Gray so esteemed his assistance that he named a Mexican Asclepiad in his honor Mellichampia. Desirous of helping others, he was one of those useful men who, diffident and retiring, and not caring to advance their own fame, are always willing to give to others the benefit of the knowledge they have acquired. It is not too much to say that but for him, considerable of value would have remained unknown of the flora of his district; grateful acknowledgements of this have come from European as well as American botanists."

"Dr. Mellichamp was an ardent lover of nature, with a poetic and artistic spirit, and his letters teem with fine descriptions of the various objects which attracted him in his professional drives about the country. He was wont, as the spring approached, to speak of the exceeding beauty of the young flowers of Pinus Elliottii, as they expanded their cones over the trees, crowning their robes of green with a haze of purple. His letters show the keenest sense of the loveliness and delicious warmth of a spring in the pines with flowers opening everywhere, the fragrance of the woods, of jessamine and of magnolias filling the air made vocal with the songs of mocking-birds.

"But best of all, he was a man to be loved for his qualities of heart and mind. A magnetic and attractive man, his friends and correspondents cannot forget his ready kindness and words of cheer and will cherish his memory. He was beloved by the poor people of his district who, in a touching way, mourned the loss of their "old doctor" as his body was borne to the grave. As might have been supposed he was intensely southern in his feelings and in his love for his native State. He now rests in her bosom, and the well-known lines, slightly altered, may well be applied to him, 'Little he'll reck if they let him sleep on in the grave where a *southern* has laid him.'"

There are some omissions in this as in all other sketches of Dr. Mellichamp's life and in order to fill in some of these I have sought further information from his relative and life-long friend, Mr. W. G. Hinson, a prominent planter of James Island, South Carolina. Letters from Mr. Hinson and a visit to his home have enabled me to add somewhat to the published facts of Dr. Mellichamp's life. In a letter of April 26, 1910, Mr. Hinson says that when graduated from the Medical College of South Carolina Dr. Mellichamp did not go at once to Europe but "was taken into copartnership by Dr. Pope of Bluffton, S. C., who died shortly after, leaving Dr. Mellichamp with a large, lucrative practice, when he took a notion that his medical education was not complete, and that he must spend a year at the hospitals in Europe. His friends tried to dissuade him from such a course, being a young man not well established the field would soon be occupied and he not able to regain what he had lost. The greatest difficulty he had to face was want of means, (His father was an Episcopal clergyman of very limited means, unable to tender him any assistance) fortunately he had an old appreciative friend who loaned him $500 which enabled him to carry out his wish. Two years after his return to Bluffton (which was a beautiful settlement on May River, surrounded by wealthy and cultured planters) his practice was much larger and more remunerative than his partner's had ever been. After the war he returned to his home, which had become almost a deserted country and was so for many years. Many inducements were offered him to go to a city, but his love of the forest and nature was too strong. He had one daughter who married Mr. Woodward (son of an Episcopal Clergyman) who is a dentist of note in New Orleans; they have several children, grown up. When Dr. Mellichamp's health failed he went to his daughter's to live, but returned on a visit to his old home, was spending a few days with me, had retired in the evening apparently well. I was aroused in the next room by a call from him and found him breathing with great difficulty. In fifteen minutes he had quietly passed away."

Dr. Mellichamp was the grandson of St. Lo Mellichamp who

"Died, on the 17th of August, 1827, at his residence, Independent Ridge, St. Paul's Parish, in the 70th year of his age—a soldier of the revolution, and a man of integrity, unblemished throughout life" In his obituary of this soldier, from which the above quotation is also taken, Hon. Henry Bailey, onetime Attorney General of South Carolina, says:

"In politics he was an undeviating Republican of the Jeffersonian stamp, regarding the people as the only legitimate source of power, and their representatives as servants, who are not at liberty to make use of that service for their individual benefit. Thus, when a member of the Legislature he refused a lucrative office, the acceptance of which his friends were pressing upon him, holding it to be a dangerous precedent that a representative should afford the slightest color for a suspicion of having used the influence of his station for his private advancement."

St. Lo Mellichamp married a daughter of Captain Benjamin Stiles who commanded the James Island Company during the Revolutionary War. Another daughter of Capt. Stiles was the grandmother of Mr. W. G. Hinson above mentioned. The Rev. Stiles Mellichamp, son of St. Lo Mellichamp married Sarah Fowler Cromwell, ~~a widow~~, and Dr. J. H. Mellichamp was their son. The following notice is copied from the old family bible:

"Joseph Hinson Mellichamp, M. D., son of Rev. Stiles Mellichamp and Sarah Fowler (Cromwell) his wife, born at Gillisonville, Beaufort District, South Carolina, 9th May, 1829; married Sarah E. Pope, daughter of James Pope, Esq., 26 November, 1858, Bluffton, S. C., and died at Stiles Point, James Island, S. C., October 2nd, 1903, at 7 a m., of heart disease.

"Funeral services performed at (P. E.) Grace Church, Charleston, S. C., 3d October, 1903, by the Rev. William Way; and buried at Saint Luke's Church yard, Beaufort county, So. Carolina, twelve miles from Bluffton, S. C., at 12 M., October 4th, 1903.

"After the Confederate war (1860-1865 A. D.) Bishop Howe, of the Diocese of So. Carolina Protestant Episcopal Church, sold the above Saint Luke's Church, located on the Fording Island road between New River and Okeetee River to the Methodists and it is now known as "Bull's Hill Church."

"The church is a quaint wooden structure on the edge of the forest road where Dr. Mellichamp loved to roam in pursuit of his favorite study of the trees and flowers."

Dr. Mellichamp's contribution to a knowledge of southern botany cannot be judged from his own publications. With the exception of occasional letters these seem to be confined to the following:

1st. Insectivorous habits of Sarrecenia variolaris in Proceedings of the American Association for the Advancement of Science.

2nd. Notes from a South Carolina Naturalist I. Garden and Forest, Jan. 2nd, 1889.

3rd. Notes from a South Carolina Naturalist II. Garden and Forest, Jan. 9, 1889.

His principal contributions were in the form of collections, observations and notes that he was constantly sending to the principal botanical scholars of the country. In his study of the Coniferae* Dr. Engelmann of St. Louis, one of the ablest botanists of the times, says: "P. Elliottii was imperfectly known to Elliott and was considered by him a form of P. Taeda. Later botanists ignored it, till Dr. J. H. Mellichamp of Bluffton, S. C. rediscovered it about ten years ago and directed my attention to it. Without his diligent investigations, ample information and copious specimens, this paper could not have been written."

In 1893 Dr. Mellichamp found on a tree of Pinus Elliottii at Bluffton some remarkable bisexual cones (androgynous cones) and these appeared again in other years (see reference to this in one of the following letters). These cones found their way to the hands of Dr. H. Christ who published a technical description of them in Le Bulletin de la Société Royale de Botanique de Belgique. He there refers to Dr. Mellichamp as "our excellent friend, Dr. Mellichamp, of Bluffton, S. C., known for his notable botanical discoveries, and especially for his studies on the pines of his country."

The following observation was written by Dr. Mellichamp in

*"The botanical works of the late George Engelmann", edited by Wm. Trelease and Asa Gray, 1887.

his copy* of Dr. George Engelmann's "Revision of the Genus Pinus."

" During this season 1880 (the winter having been very mild) *Pinus Elliottii* flowered from *1st to 10th of February;*—*P. Australis* and *P. Taeda* almost together about the first week in *March*—the former a little in advance;—*P. Glabra* a little later,—and *P. Mitis* and *P. Serotina* almost together from *1st. to 10th of April*,—the former being a little in advance.

1—	2— 3—	4—
P. Elliottii	*P. Australis and P. Taeda*	*P. Glabra*
1st-10th Feb.	1st-10th March.	10th-20th March.

5— 6—
P. Mitis and P. Serotina
1st-10th April.

J. H. Mellichamp,
Bluffton, S. C.,
20 April, 1880.

In order to arrive at a clearer conception of Dr. Mellichamp's characteristics as a man and naturalist, I have examined a number of his letters that were kindly sent me by Mr. Hinson, who says:

"I have sent you a number of letters with the package sent by this mail, thinking they would give you a clearer understanding of his nature than anything one could say. His being named after my father would naturally cause an interest in him, but it only needed contact with him to be won by his pure and lovely character."

From these letters I have selected the following for publication knowing that they will be more appreciated than any other part of this contribution. The letters, unless otherwise stated, are addressed to Mr. W. G. Hinson, Stiles Point, James Island, S. C. Notes and corrections are by the editor.

*Now in possession of Mr. W. G. Hinson.

Bluffton, S. C.,
24 June, 1892.

My dear William:

Thanks for the specimens of Tilia (Bass-wood, Linden) which you sent me.

I take them both to be *Tilia pubescens*. It differs somewhat from the tree in the mountains and northward—but not much.

Near New River I saw on the *road* a young tree 10-12 feet high which is the only true *poplar* (I don't mean the "Tulip tree"—but the "Cotton wood") which I have seen in the low country, but which is a different species from your "Carolina Poplar" which is found higher up the country and at the north too, I believe.

This I enclose is therefore (so far as I know, and so stated by Elliott) *Populus Angulata** and is a Cotton wood. or *poplar* or *aspen*, and the only low-country poplar we have. The *other* poplar (so called) is no cotton wood—or aspen but the "Tulip tree" or "White Poplar" and its scientific name is as you may know "*Liriodendron Tulipifera*."

Yours truly,
J. H. M.

Bluffton, S. C., 29 March, 1895.

My dear William:

Robert tells me that you want to know where, or how you can get a copy of Dr. Engelmann's "Revision of the Genus Pinus" that contains my old friend "*P. Elliottii*"—the one I rediscovered and sent to the Doctor with my notes etc., from time to time. Yes! a delightful correspondence I had with that genial and kindly man! Well! I don't know where you can get a copy—unless indeed you were a Gould or a Vanderbilt and could bribe some impecunious botanist to whom Dr. Engelmann may have sent the book, for such things are not found in the book stores! I am glad that I can help you and that too without hurting myself. It so happens that through the courtesy of the old Doctor's

*The "Populus Angulata" here referred to (leaves of which are still enclosed) is the true "Carolina poplar" and is now properly known as Populus deltoides Marsh.

son—Dr. George J. Engelmann, and Prof. Trelease of the Shaw's Gardens of St. Louis, and still more through the good Mr. Shaw himself, (who published in one splendid volume all of Engelmann's works), I have a copy which of course includes Dr. Engelmann's *P. Elliottii*. So I have sent it on to you but with *this agreement* which you must promise immediately to carry out, viz: that you will have it bound! It need not be bound expensively, just in boards and tipped on the edges and back with calf or sheep. It won't cost much, but I owe that much to Dr. Engelmann's book. I was afraid I had lost my copy of the pamphlet in a villianous house-cleaning last year, but today I set to work and by good luck found it. And so send on at once to you.

For certain reasons, chiefly to avoid the possibility of its getting into some careless darkey's hands, and its getting mashed up or upset overboard in the Ashley when being carried over to Stile's Point, I have addressed it—registered to Robert† at Chisolm's Mill, and he is a careful man you know, and will put it into your hands safely. What villianous paper these Jews have sold me—the point of my pen actually goes through the paper. Did the pines come all right?

Yours affectionately,
J. H. Mellichamp.

P. S. In 1893-Feb., I found a piece of *P. Cubensis*, *P. Elliottii*, (Engelmann) with most remarkable blooms—many of the aments or catkins having the male or female flowers united, or *bisexual* or *androgynous* which ever you please, and they again appeared in 1894 and 1895. I send you a specimen pressed in the pamphlet. It is not a very good specimen but will do to show.*

Bluffton, S. C., May—'95.

My Dear William:

I received a delightful letter last night from Robert,† in which he told me with great sweetness and simplicity and abounding sympathy, of the great success of the reunion which you inaug-

*The androgynous specimen still accompanies the letter.

†Robert Mellichamp, his brother.

urated and carried out. I am very glad of it, and I congratulate you with heartiness.

What I chiefly write for now is to ask you, if it is convenient for you to do so, to send to Dr. F. Peyre Porcher, Pinopolis, S. C. (Julian's brother) the copy of Dr. Christ's paper on the Androgynous Catkined pine, which sometime ago I sent you. I sent a small specimen to Dr. Porcher and he seemed interested in it and asked him to send him any paper, etc., of mine, and this is next kin to it. But do not send him my bungling translation, send only the French. Ask him to be sure and return it to you, and don't forget to give him your address. Also enclose him stamp for the return of it, which I enclose. I who am so rarely sick, had a pretty bad attack two days ago, bordering on inflamation of the bowels—due I think to check of perspiration on the bluff after being well heated by a walk. I am now well, but extremely weak.

Affectionately Yours,
J. H. M.

Bluffton, S. C., Feb. 23, 1896.

Rev. Jno. O. Wilson,
Greenville, S. C.

Dear Sir:

I have received the box containing the beautiful specimens of the yellow-berried holly, and I thank you very much for your courtesy. Upon comparing your Greenville specimens with our common holly on the sea coast, I can see no difference save in the size, shape, and color of the berries which are, I think, almost twice the size of ours here, besides being much rounder, and of a bright yellow color. I think also the leaves which you send have stronger and heavier spines than what we find on some trees, but I have seen the spines equally as strong and numerous on different trees with us. Undoubtedly your tree is the same as ours—Ilex Opaca. I send you with this note two or three specimens from a handsome tree growing near my house. You will observe that some of the leaves are entirely free of spines, and that the berries

are not as round as yours, and are very much smaller—still both trees belong to Ilex Opaca.

The only holly with yellow berries, which I have seen, was Ilex Myrtifolia, a so-called "variety" of the rare and beautiful Ilex Dahoon, which grows sparsely in swamps along the sea coast. This "variety" I have never seen growing on salt water, but higher up the country, so far up as Orangeburg county, around pineland ponds. It has been seen with yellow berries about Wilmington, N. C , from which place the late Dr. Thomas F. Wood sent me fine specimens. With thanks for your kindness, I am

Very respectfully yours,

J. H. Mellichamp.

This letter is copied from a newspaper clipping of date, March 19th, 1896, in possession of Mr. W. G. Hinson (probably from a Greenville, S C., paper). At the foot of the clipping Mr. Hinson has written as follows:

"Dr. Mellichamp and myself found both growing in same pond near Summerville in 1898."

Charleston, S. C., August 14, 1897.

My dear William:

When I sent you P. card I forgot to send you also a copy of "Garden and Forest" of Aug. 4th, which I think you will find interesting. I refer you to the articles marked. You can keep them. Suppose you look for H. [Hicoria] pallida in your mountain region, and be sure and save a good specimen of leaf and fruit for me! You have the guide! Yours truly,

J. H. M.

Chisolm's Mill, Charleston, S. C., 2 Sept., [1897?]

My dear William:

Robert hands me your post card so I reply at once. Am glad to know that you looked for Mr. Ashe's *Hicoria pallida*, and perhaps have found it,—will be delighted to see it. Suppose you received the copy of Garden and Forest containing the plate and etc. But you must try and bring also the *nut* in its present con-

dition of growth, and anyone of last year's growth also—if you can!

Mr. Ashe has sent me a specimen of *H. pallida* nicely pressed with nut also. I am getting along and have not bothered to go up to see the Dr. for I believe 3 weeks—and have long since thrown his "truck" to the dogs! R. [Robert Mellichamp] sends regards. J. H. M.

Foot of Trade St., 16 Dec., 1897.

My dear William:

I thank you very much for the fine specimens of Holly which you sent me, and I am curious to know where they came from.

It would not surprise me to find one of them (Ilex Dahoon) on James Island—but the other two (*Ilex Myrtifolia*)† I have never seen on *salt water*, though I have seen it near *Hardeville* both with *yellow* berries and *red*. I refer to the small leaved varieties.

In the *middle* country they are found in, and around pine-land ponds, and they become small trees with very white and smooth bark. They are very beautiful. Let me know where they came from,—if from *James Island*,—at what place,—and is the *yellow* berried form abundant? The other tree with larger leaves and *pink* berries is Ilex Dahoon, and becomes a small tree. It is the *arrow leaved* form of *Ilex Dahoon*. Let me know. I sent these specimens (they were so fine) to Dr. Wm. Trelease of the Missouri Botanical Garden at St. Louis, so if it be convenient for you to get other specimens of *Ilex Myrtifolia* with *yellow* berries and *red* also, I'd be glad—but do not put yourself out or take any special trouble. Yours truly,

J. H. Mellichamp.

P. S. This thing which I enclose (*Illicium parviflorium*)* I found up at *Chicora Park* much of it growing on the avenue just in the rear of the old Turnbull brick house leading to Cooper river.

†Mr. Hinson writes me that he thinks he got this from Summerville, S. C., which is not on salt water.

*The leaves of Illicium are still with this letter.

Have you any of it? It is worthy of cultivation. Leaves when brusied smell delightfully of *sassafras*, or *heart snake root*.*

J. H. M.

I saw one tree up there 35-40 feet high! Elliott says they usually grow 6-10 feet high. J. H. M.

Charleston, S. C.,
Foot of Trade St.,
Friday, 14 Jan., '98.

My dear William:

I have heard that you were back from your duck-hunting trip, but whether you were over-laden with ducks or not—I did not learn! But I hope you had a pleasant time—as pleasant as the one I had in the same Waccamah region with my dear friend Dan Tucker† in the days long past—the days that are no more! Please thank Mr. Ellis for sending me the medical books which I left at your house. I hate to leave, but I *must* go, and expect to start for Bluffton early on Monday morning. I shall remain there a few days, then go on to Savannah, and after a day or so shall boom on to New Orleans. What fate has in store for me *there*—God only knows! I have heard from my friend, Mr. W. W. Ashe, *Chapel Hill*, "*N. C. Geological Survey*" after he received my leaves of the oak which you showed me on the Battery. He says I'm right, that the "Darlington oak"‡ is our "Water Oak"—*Q. laurifolia*, but if you do get specimens of the oak from your friend in D—n, [Darlington, S. C.]§ I wish you'd send them on leaves, acorns and all, and any "notes" you may have about the tree. Goodbye my dear William if I don't see you again.

Yours truly,
J. H. Mellichamp.

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*This is Asarum arifolium Michx., often called "Heart Leaf."

†A wealthy rice planter of Georgetown, S. C., and a class mate of Dr. Mellichamp at the South Carolina College.

‡More widely known as "Laurel Oak." The name "Darlington Oak" comes from its use as a street tree in Darlington, S. C.

§He refers here to Mr. W. D. Woods, of Darlington, S. C., who has been interested for years in the trees of his section. He is still living.

New Orleans, La.,
Cor. Fern and Elm Sts.,
18 Feb., '98.

My dear William:

I am sorry that I did not reply just as soon as I received your letter with Mr. Ashe's papers, but the fact is, I was not very well and so put it off for a more convenient season!

And if a thing cannot be well, and properly, and faithfully done, it seems to me it had better not be done at all, and so stands the case about the queries as to the young live oak, and the young magnolias! If I could only have received these queries when I was last in Bluffton, I could have answered them *accurately* but now I cannot do so, and I do not wish to trust to my memory of some years back when I not only planted the live oak acorns, but examined the young roots after a year or two and even reported the results to my dear friend Engelmann of St. Louis *who had been put on the track by Wm. St. J. Mazyck* who spent a pleasant morning with me at the mill, when I was last in Charleston. The results are published in Dr. Engelmann's works I think. Should I ever get back to the low country in S. C., I shall take the greatest pleasure in examining both the live oak and the magnolia,—but now I'd prefer not to trust too much to (perhaps) a treacherous memory! I am very sorry! I enclose Mr. Ashe's papers as perhaps you will need them. I thank you very much for getting and sending the specimens of the so called "Darlington oak" to Mr. Ashe.

When I was last in Bluffton I sent him quite a lot of specimens of a curious oak which I had found on the roadside some years before which *seemed* a *hybrid* between the "Water oak," our low country "*Quercus* (laurifolia)", and the "*Q. Cinera*", and it had two sets of acorns, the *one* "*annual*," the *other* "*biennial*," that is, the one set *maturing* in *one* year, like the "Live oak,"—the other in two seasons like the "Water oak." It was very curious, and evidently all is not known yet as to the queer ways of our oaks!

I like this old place very much, and everybody here is at this present time talking and talking and talking about the "Mardi

Gras'' or whatever they call it. I am sorry that such things do not interest me now,—but thank God! the woods and fields and trees and plants do interest me still.

Two of my grandchildren have been sick with grippal pneumonia and pleurisy, and Herbert from having been overdone by a long bicycle ride away off to Lake Pontre-Chartrain (or however these French people spell it) last Sunday.

Both thank Heaven are now well. Mary sends you much love, —she can't forget those very happy days you and yours gave her long ago at Stile's Landing! Well, I must have tired you out my dear William. Yours truly,

J. H. M.

I had one ''bout'' the other day, waiting in the streets with Iva for the street cars,—losing somewhat of speech and with a kind of a dull and stupid feeling in the head, and the *effects* I felt certainly for 2 days! Now I feel quite well. When you see Elias Rivers give him my love and do William look after my dear Robert* for me and let me know about him.

New Orleans, La.,
Cor. Fern and Elm Sts.

My dear William:

I received your letter enclosing one of Mr. Ashe's last night and reply at once about his pine. What he alludes to as the ''Slash Pine'' is nothing but the same pine as the seedlings which I send you from Bluffton—otherwise called the ''Cuban Pine'' (P. Cubensis), or P. Eliottii, [P. Elliottii], or P. Heterophylla, which Elliott first called it as a variety of the loblolly pine (P. Taeda) but he never made a greater mistake in his life, as it is no ''variety'' but a true and genuine species. It is the only pine on our coast which has purple ''catkins'' or flowers except the long leaved yellow pine (P. Australis) and it bears its leaves as I have shown you by twos and threes. The scales or flakes of bark are also thinner and longer usually than those of the long leaved pine and of a kind of violet or bluish or pinkish color. You will hard-

*Robert Mellichamp, brother to Dr. Mellichamp.

ly find it in the Island. I only saw one tree there when I was a boy in College, and it grew on the bluff or edge of it, not far from the Nartello tower. It was the first tree of the kind I ever saw, and I was struck by the appearance of the cones—their beautiful shape and color. I collected a good many of them for my dear Sister, as she was (at the suggestion of Wm. M. Lawton) making basket work of pine scales for the great exposition in London at that time. She received her testimonials through Mr. Lawton. I never saw another of that species of pine on James Island although I always kept my eyes open, but I did see the pollen from similar trees wafted in immense clouds (*earlier than that of any other pine*) when I was fishing or exploring in Great Creek or about Black Island.* I once killed on Black Island an old eagle and two grown young ones, and the nest was also on one of these trees, (P. Elliottii). Pardon my dear William the garrulity of age and my allusion to these delightful days, the happiest of my life. I shall never see the like again, and it is a delight to allude to or think of them! I feel pretty sure that I saw the same tree growing on "Goat Island" in my trip with your father to Bird Key, but I guess you won't find it now on James Island. I wrote to Mr. DuBois in Bluffton telling him that I'd be glad for him to send specimens of the tree to Mr. Ashe and I'd send stamps, but I do not know whether he had time or inclination. I sent Mr. A. the same androgynous specimens which were just commencing to bloom when I left Bluffton, and this is what he alludes to in his letter to you. Had I known that Mr. Ashe wanted specimens of P. Elliottii when I was last in Bluffton, I would have taken pleasure in getting them, or having them gotten by somebody at the right time, if Mr. DuBois couldn't get them—but he may get them as I know him to be kind and obliging.

We are in the midst of all the row of Mardi Gras about which

*These observations on the occurrence of Pinus Elliottii at and near Charleston (James Island lies right across the Bay from the Battery) are very interesting. Mr. R. M. Harper who has carefully studied the distribution of this pine says: "It perhaps does not grow within thirty miles of Charleston." (Bulletin of the Torrey Botanical Club, Vol. 34, page 375, 1907).

the French people go mad, but I did not go out last night with John W. and his boys, as I find it impossible to feel any interest (Alas! Alas!) in such things. But I'll try tonight unless I get too "stubbornt" as the Crackers say. If Mary was down stairs she would, I know, send her love. John W. is in partnership with a fine man and I may say he is doing well. I wrote you a few days ago, returning Mr. Ashe's letter and the Darlington man's.

Yours very truly,
J. H. Mellichamp.

New Orleans, La.,
Cor. Fern and Elm Sts.,
April 18th, 1898.

My dear William:

I fear you are thinking me a troublesome customer, but I can't help it, as I greatly wish to oblige Prof. C. S. Sargent. A short while ago Mr. Sargent wrote me, begging me to send him from the sea-coast a good specimen of our common *Red Cedar* as there were questions about it and the *Bermuda Cedar* which he was anxious to settle. I immediately wrote my friend Mr. DuBois of Bluffton, enclosing to him Mr. Sargent's letter, and asking him to send him a specimen with *the berries* (if possible) but I have since heard from Mr. DuBois as to other matters, and as he did not say a word as to my request (I sent stamps), I fear that my letter miscarried in the mail. Now I've just heard again from Professor Sargent and he thanks me for my attempt, but up to that time the cedar has not arrived, so I conclude that Mr. DuBois did not receive my letter. But Mr. Sargent wants specimens from *different places*, so I write you, begging you to send him a specimen or two *with the berries*, if possible, and on the parcel putting on your name thus, "*Botanical specimens*," from Wm. G. Hinson, James Island, S. C., then the address thus—Prof. C. S. Sargent, *Arnold Arboretum, Jamaica Plain, Mass.*

That will keep the parcel from being torn to pieces by mail people probably. Yours affectionately,

J. H. Mellichamp.

P. S. The *Trillium* I wanted was sent me by our old friend

from St. John's, Mr. Porcher, so you need not think of it again. I sent Robert Mellichamp a specimen for you, so that you may *know* it.

May sends her love to you. I am feeling very well, but I am too dull and stupid—indeed *that* is now I fear a chronic contagion with me!

"Solemn before us, veiled the dark portal."

"Grave of all mortal"! J. H. M.

New Orleans, La.,
Fern and Elm Sts.,
26 May, '98.

My dear William:

I replied to your kind letter yesterday, but in reading it over again this morning I find there were one or two queries which I neglected to reply to. You ask if I had seen Dr. Chas. Mohr's book on Forestry. Yes, I have it, sent me by Dr. M. a few years ago. This was the edition of '96, but yours is I suppose a later and last edition.

The old Doctor paid me a visit in Bluffton some years ago, and stayed a few days with us. We were all very much pleased with him. He is an accomplished man. He is a druggist in Mobile and has sons and daughters too I think. His home is but a short distance from this city, as you know, and he spent a day with us the other day, dining with us, etc. I fear his health is not as good as it was. He looks much older, and he is now an old man. I may one of these days take a trip to Mobile, and perhaps go about with him a little in the woods. He is a most pleasing man, and has been all over the world.

That magnolia which you met with in Mr. Middleton's garden may not really be the same as the "Umbrella tree" in the C'h woods. It *may* be the "Magnolia Macrophylla", which is "found in Tennessee and 10-12 miles to the S East of Lincoln court house, North Carolina." Elliott. The leaves are very large "They have been found thirty-five inches long, and 9-12 inches wide," etc. I wish I could see it in its native haunts. The other

day I was strolling (over a month ago), and I stumbled over a water plant in "Audubon Park" which I had been looking for all my life in our low country, but never could find. It was the "Tawny Iris." Irish Cuprea Pursh. I found a great many growing in a ditch in the park. I became as you may imagine very much *enthused*. It was like meeting a very old friend. Elliott says it "grows in the marshes of the Altamahah" and cites LeConte. I enclose a small specimen, and when the seeds are mature, I shall manage to get some and let you try them in some bog near your house, if you have *such a thing as a bog* now, which I am afraid you haven't!

And so the poor little Seabrook boy has gone or is going the way of all flesh, except wise old fellows like W. G. H., but then its doubtful, for you manage to take the cares of other people upon you in addition to your own, so nothing is gained after all! I shall in a few days send you a few acorns of the Texan Oak (Q. Texana) which the people grow on their sidewalks, and you can try and grow it at your place. Well, I believe that is all I have to say just now.

Yours affectionately,
J. H. M. (Mellichamp.)

New Orleans, La.,
Fern and Elm Sts.
27 June, 1898.

My Dear William:

I received your letter some days ago, and thank you for the enclosed specimen which you sent me. I examined that flower some fifteen years or more ago and if I remember a-right could not find it in any Southern Bot. work which I had, either Elliott's or Dr. Chapman's and of these I have at present only Elliott's. I think it is no Southern plant, and don't know why it should have been planted by the *Perronneau** people as I suppose it was. I think I must have sent it to Dr. Gray, of Cambridge but I have forgotten the name, but think it commenced with a C.

*An old Carolina family of James Island. Their place is now owned by Mr. W. G. Hinson.

Today I sent it to Dr. Mohr* of Mobile, who lives near here, and indeed came to see me the other day, spending the day with us, and dining with us. Nice German gentlemen and accomplished wants me to go and see him. I'll write you again when he gives me the name.

Something I want you to do for me again. I want a specimen of the *Gonolobus Vine* that bears yellow flowers and grows on the road near the gate to the *right*, where I got the pink flowered Eupatorum which you got for me on the *left* of the road. The vine exudes milk when you pluck the flowers or leaves.

[Sketch] The petals are somewhat *veined* and the leaves are generally large and heart shaped [sketch] and rather hairy. The specimen ought to have one or two clusters of *pale-yellow* (*sometimes* brownish purple) flowers, 6-8 inches long and pressed, and keep till dry, or flat. If troublesome don't bother, and you can send one little bit of the other, the *pink* Eupatorum, but if either of these be gotten, you must carry with you a book, and on the road press at once before wilting occurs. The Gonolobus bears a round capsule which is *prickly*. [sketch] The other kind has *angled* capsules and very smooth and grows on the McLeod road and has *purple* flowers—dark purple [sketch] petals not *veined* and sharp pointed.

Yours very truly,

J. H. M. [Mellichamp.]

New Orleans, La.,
Cor. Fern and Elm Sts.,
July 13, 1898.

My dear William:

I received your package of beautiful plants a mail or two after your letter came, and I thank you very much. The plant *Gonolobus hirsutus* was just what I wanted, as I wished to compare it with a vine which I found growing here occasionally in the gardens, and even along the sidewalks.

*Dr. Chas. Mohr, a druggist and a botanist of distinction. His large work on "The Plant Life of Alabama" is well known.

If I can find the right book which I pressed it in, I shall enclose it in this letter. I was quite curious about it, especially as I had left Dr. Chapman's book at home and therefore could not satisfy myself about the name. However I sent a fragrant of it to my good friend, old Dr. *Chas. Mohr* of Mobile (he came to see us the other day and spent the day with us) and he gave me the name stating that some weeks ago he had collected it himself in Central Ala.

It is not found about our Sea-island country of South Carolina, so it was quite a stranger to me. It has the yellow or straw colored flowers of your *hirsutus* but not the shape of the petals, and its leaves are exactly like the vine that grows along the McLeod hedge, and the flowers are of the same *shape* only they are not *dark purple* as *they* are but (as I said) yellow or straw color. Dr. Mohr said it was *gonolobus flavidulus*. Here is an outline of the petal of your hirsutus [sketch], here is one of *flavidulus* [sketch] the one more rounded and blunt, the other more narrow, and sharp pointed. The difference *you* may say, "twixt tweedledum and tweedledee." But both your plant and mine of New Orleans have their flowers straw colored.

Much ado I'm afraid you'll say about nothing, and yet these distinctions are absolutely necessary! As I told you, May and I did not get to see your friends down town, for my own sickness or indisposition with the downpour of rain prevented and we could not go and now we see from the paper that they (at least the ladies) had *gone* to Saluda, but we shall go again if there are any left. We liked them all *very much*. It would give me an immense amount of pleasure to come to your house and stay while with you, but I don't know if I can compass it. But I must think it over.

I heard yesterday—long letter—from Mr. Arthur Huger. He is at Waynesville, N. C., at Pink E. Hyatt's. That vine of yours G. hirsutus (hairy) that has the straw color or yellow flower—has also sometimes flowers *dark colored* a *kind of chocolate color*, but different from the G. M. (Gonolobus Macrophyllus Michx.) at McLeod's fence. The fruit of the former as you must know, both

the chocolate and yellow colored kind is *round* and *prickly* and that of the other *smooth* and *angled*—not round.*

Yours affectionately,

J. H. M. [Mellichamp]

Fern and Elm Sts.,
New Orleans, La.,
26th Aug., 1898.

My dear William:

I received your card yesterday, and thank you more than ever for your affectionate invitation. You are very good to me, and I feel sure I would have a grand time with you and Mr. Brewster in the woods and everywhere—but I cannot come! Some other time perhaps if it suits you in the days to come—I shall give myself that pleasure—but not now!

How curiously a man talks of the future—"Days to come," as if I had the years of Methusaleh ahead of me, and had not already almost hoed out my row of the three score years and ten! Well! it's no wonder we cling to the years we have known and hope to have here,—for after all it is all we know, and we know nothing of the other world—the world to come! I hope it is a good place and hope I shall get there when I go—but it is doubtful. I much prefer this present world with its uncertainties and Deviltries—it being the only one I *know*!

But all of such talk is nonsense—let me talk of things more pleasant. About two weeks ago John Woodward had a little holiday of two weeks, and we agreed on taking a small "outing"

*In addition to the two sketches of petals inserted in the positions indicated above there are two marginal sketches of the fruit of Gonolobus hirsutus and G. Macrophyllus respectively.

Gonolobus flavidulus Chapm. is now generally considered only a variety of G. hirsutus Michx. The earlier generic name of Vincetoxicum has been adopted instead of Gonolobus for these species and they are now known as Vincetoxicum hirsutum flavidulum (Chapm.) Vail. and Vincetoxicum gonocarpus Walt. Inclosed is a specimen of "Gonolobus flavidulus" (leaf and flowers).

with grandson *Joe** at Covington, which is some 30 miles from New Orleans. And so we went,—and a delightful time we had—or rather I had, for it rained more or less the whole time we were away. The hotel was full where we expected to be entertained, so we went out into Pinelands, some three miles off, with a German—or rather the son of a German, by name of Zeit Vogel, who took care of us and did the best he could (which was not much) for our comfort. His house was on the banks of a little stream with an Indian name—*Bougfalayah* he called it, but I don't know what that means, but it sounded Indianlike and all right, so John and Joe thought it would at least give them a few cat-fish, or a perch (pache, the Savannah River niggers call it) or trout. So they rigged up their lines and tried the most inviting looking spots on the river—but not a bite did they have. John evidently was in hopes of doing *such* fishing as that he used to do on the "Rocks" in May River—or about Dawfuskie, or Calebogie—but it was no use—they did not have a bite, so they were just in the humour to accept my invitation to other fields and "Pastures New," and that was into the beautiful Beech and Magnolia woods on the banks of the Bougfalayah, where it seemed likely I would see some fine things. And so we did. I soon got John and Joe into an enthusiastic humour, and in a little while I had them showing me, or bringing me the finest or most wonderful specimens of shrubs and plants. It is curious, isn't it?—how you can get people by a sort of contagious enthusiasm into exactly the right mood which you would wish them to be in to help you!

The first thing I struck was *Illicium parviflorum* (or Floridanum) of old Michaux who first found it I think on the St. John's River in Florida. I have searched *our* woods in Carolina in vain for it —never could find it *in the woods wild*, and saw only one shrub on the Okeetee which had been dug from poor Langdon Chevis' garden on Savannah River when he was engineering at Batten Wagner and losing his life too! Poor fellow! I liked him so much, he seemed a very accomplished man when I met him at the Hilton Head forts. I next met this shrub last year at "*Chicora*" (Turnbull's old place) where I saw one tree about 40 feet high,

*Joe Woodward, a grandson of Dr. Mellichamp.

but no tree there had either flower or fruit. But those on the Bougfalayah river were full of fruit, and Joe with a great air of triumph brought me a single flower—growing out of all time and season from a shrub. I guess this shrub is in the gardens of Sav. and Charleston, etc., but I never saw it *wild* and growing in the woods but near Covington. I saw other things, but I weary you, so stop, and I thank you very much, my dear William.

Yours affectionately,

J. H. M.

P. S. If I can squeeze into this letter a specimen of the *Illicium Floridanum** with leaves and *fruit* I shall do so, and I'd like you to keep on the lookout for it, but I don't expect you to find it. If Mr. Dill is up there will you please give my regards to him.

New Orleans, La.,
2 April, 1900.

My dear Robert:†

I think I sent you a postal a day or two ago, telling you that both Prof. Sargent and Mr. Canby had suddenly burst in on us—asking me to pilot them through the Covington swamps and show them the fine *Illicium* which I had found there a year or two ago.

I wish I could have had them to dinner, but my poor daughter was badly fixed for it, being be-devilled by servants as she was who might be termed of the Devil incarnate order. So after my making an agreement to meet them next morning at the Depot (Sunday) they bade me goodbye. I found Mr. Canby a charming gentleman and brimful of humour—he and the Prof. poking a great deal of fun at each other, to my great amusement. For the last fifteen or twenty years they have been travelling more or less together over the whole of the U. S., both South and North,—but Mr. Canby had never been in New Orleans before,

*Specimen enclosed of Illicium floridanum Ellis. Illicium parviflorum Michx. is another species that is supposed to be confined to Florida and Georgia.

†Robert Mellichamp, his brother.

so everything was fresh and new to him. The next day they both went to Miss. City (wherever that may be) but they did not find what they were after—(a haw, I think, Crateegus) and upon the whole they didn't seem to think Miss. City any very grand place I suppose for lack of the Haw!

So at four o'clock Sunday morning I got up, fearing that I might oversleep myself, and I guess it was perhaps a half or two hours before Herbert* and I were off into the street cars bound down town—but the two travellers were not to be seen. A great many Franco-English Fishermen were crowding the platform with all sorts of rods and reels and fanciful baskets—the former of which I thought would have delighted the eye of Father.—(You remember what a taste he had in going up to "Stones" on a fishing expedition.) But we saw no Mr. Sargent and no Mr. Canby with their accoutrements to entrap their floral treasures and we had almost given them up, when almost at the last moment here they were all chip and cherry and not thinking they were too late—as *is the way with* old travellers!

The cars were packed with all manner of people, all more or less bent on fishing seemingly in the Pont Chartrain, Lake County, and so packed were the cars that we could not get a seat together,—but the whole scene was so new and strange and pleasant with a kind of Frenchy air that I at least enjoyed it immensely.

Pont Chartrain, on the edge of which we travelled for a long distance through marshes and bogs, is I believe some 16 or 20 miles wide and at last we seemed to cross it completely when eventually we got over into a desolate pine-barren country and then we made good speed. Prof. Sargent seemed very much interested when I told him that I expected to meet with on our journey a good many trees of the *Smooth Spruce* (Pinus Glabra) which I promised to point out to him. He seemed very much surprised, having expected to find them in a flat, clay like country, but I told him we would come to cave-like drippings in the woods—unless I was greatly mistaken where we see them. But on and on we went

*Herbert Woodward, a grandson of Dr. Mellichamp.

and no *Pinus Glabra* did we see and I commenced to feel a little foolish, thinking that perhaps I had seen the trees in some other region, maybe in *Alabama* or even in Carolina, but all of a suddent—(as Crackers say) here was a low dip and here were the Pines first discovered by the St. John's Berkley Englishman, Walter, who settled and married in that Parish and who was buried on "The banks of the Santee." Dr. Peyre Porcher was his descendant and ~~hired~~ his botanical tastes, and the Charlton family in Sav. Ga., are also his descendants. Walter married a Miss Peyre and I suppose that it was from that family that Rush Gaillard's brother, *Peyre Gaillard*, took his name. Kinsfolk I know they were. Mr. Sargent, I could see, was very much pleased to find another station so far west ~~and~~ for *P. Glabra*, as he maps out the bounds and measures of the different species, and evidently he was quite unprepared for this new place.

I told him I'd show him a good many along the Bugfallgah—or whatever the name may be. That is the river which runs through the swamp 3 miles from Covington, and I did show them to him *there* and further on the R. R. So I saved my bacon, as I may say, for really I commenced to tremble in my shoes (as Squire used to say) and feared that my Pinus Glabra was not "Comeatibus in Swamps"—but it was!

At last we reached Covington and I looked for the Dutchman (Mr. Berg or Burg) to whom I had sent a postal to meet us with his team, but no Mr. Berg was to be seen, so at last Mr. Canby hired a buggy with a scary, balking horse—he and I taking the back seat and Prof. Sargent and the driver in front and away we went for the swamp three miles off.

A lovely and a most brilliant day and cold enough to make even my heavy old overcoat comfortable and I commenced to feel even still more happy than when I was travelling on Pont Chartrain and almost as happy as on that never to be forgotten day which I spent in the Church Woods with our dear Father in November—a year or two before our war of ruin and disaster. Have I ever forgotten the Beech trees and the sunlight in their green and yellowing leaves or the towering pines of *P. Glabra* or the long, deciduous, banana like leaves of the beautiful Magnolia—the first which I

had ever seen—or Father's enjoyment of the scene—his enthusiasm, his lovableness? No, let my right hand forget its cunning before I forget that day of all days—or I forget that sweet day which I spent with you—Xmas day, wasn't it?—when we went down May River together to Old Island and we saw many of the wonders of the world there and came back home brimful. No, I won't forget *that* day either—never. Well, such a day was yesterday with Prof. Sargent and Mr. Canby! They were as happy as boys, and I not so far behind, and I won't forget that day, either. They were very courteous and good to me, and a grand time did we have on the roadside, for at times we jumped out of the buggy and we admired the splendid trees on the edge of the Caves,—the early flowering shrubs, and all of a sudden here was *Illicium Floridanum* in full and bounteous bloom from top to bottom. We never expected such a sight—the crimson flowers were very beautiful to us and never had any of us seen such a profusion of flowers. Mr. Sargent was inclined to think that this shrub differed a great deal from the *Floridanum* and I would not be surprised if he did not make even a *new species* of it. Such profusion I never before saw, and the flowers in full and perfect bloom from top to bottom, and almost everywhere—and strange to say, the shrubs growing in whitish, sandy land, but still, near the waters of the Caves. Never saw anything like it in my life before, or such enthusiasm on the part of those *Veterans*, I may say.

Still, we were, I may say, just on the edge of the Swamp and the perfect glories within had hardly been revealed to us. I had promised to show Mr. Sargent a shrub like tree full 30 feet high—measured at least it had been by John Woodward's careful eye, but that tree I could not find—greatly to my *discomfiture!*

I had given to Mr. Sargent John's very good and accurate plot of the swamp and his idea of the position of these one or two largest trees, but although I found several or many which were 15 feet or perhaps 20 feet high, the 30 foot one I could not locate. So we had to leave the swamp without finding it, *yet I know it is there*, and I think John could find it if he too should come once more into that beautiful region. Mr. Canby was always talking about *lunch*, but I thought we could go on, so Mr. Sargent agreed

with me to go on and on, for I was in that state of enthusement (such a word?) that like Tennyson's Brook, I felt as if I could go on "forever," and neither of my friends were at all far behind me! but I must stop my too swiftly *current* and *hilarious* pen, is it?—for the time flies as I'm writing an account of these delightful hours spent yesterday and I must keep my engagement to meet Mr. Sargent in an hour or so at the St. Charles Hotel to take lunch with these "grands hommes," as I must call them, and then I'm to carry them to the City Park to show them some grand live oaks and a hickory tree (C. Aquatica) of which I sent Prof. Sargent some months ago, the finest he said as to *fruit* he had ever seen.

So time is flying and go I must and finish my letter another time, so for the present goodbye, and I'll send you one or two of the specimens of *Illicium* when I finish. J. H. M.

Late in the afternoon and I've just returned from City Park, where I spent a pleasant time, but not approaching the glorious times of yesterday—such delights (from their novelty also) don't come to us every day—about 3 or 4 times in a *whole life time!*

Better so,—we will value them the more when they do come! We are not apt to get a surfeit, that's certain.

I showed Mr. Sargent the two grand oaks—*Louisiana* oak and the *McDonough* oak, but told him there was one at Caper's Landing, S. C., bigger still—but in my day even it had been mutilated by hurricane and cyclonic storms. They gave me a grand lunch of sheepshead and other fine things at Mr. Victor's—a sort of French Restaurant—where we were admirably served, also nice Claret which I very much enjoyed, winding up with Cafè noir.

I could tell you more about the original trip and all the other fine things we saw, and the fine things we did, but I'm a little bit tired and I guess I have said enough for one time—only I must allude to our balking horse d—l that I almost feared he was going to kill us, but we got off slick enough.

Love to Stiley. I dare say he got my love letters.

Affectionately,

J. H. M.